PHYSIOLOGY AND HYGIENE

FOR GIRLS' SCHOOLS AND COLLEGES

E. S. CHESSER, M.B.

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PREFACE

It has for some time been recognised that the education of girls must include a comprehensive training in what will fit them to be efficient in the home sphere. This book aims at supplying a knowledge of home hygiene, dietetics, cooking, and personal hygiene, which will be of service to girls in after-life. The subject of elementary physiology is given in sufficient detail to make the book suitable for examination purposes, and I have included sick-nursing, first aid, and child management, in order to conform to the Collegiate Syllabus of the Institute of Hygiene.

Whilst many of the illustrations have been specially prepared by my husband, Mr. Stennett Chesser, I have to thank Dr. Strickland Goodall for the original drawing illustrating the psychic factor in appetite. I am indebted to many people for valuable suggestions and helpful criticism, more especially Dr. Murray Leslie, Miss I. M. Oakden, M.A., and Mr. Grant Ramsay.

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PHYSIOLOGY AND HYGIENE

CHAPTER I

CONSTRUCTION AND BUILD OF THE BODY

The meaning of hygiene, anatomy, physiology—The skeleton—Skull—Vertebral column—Thorax—Upper limb—Lower limb—Joints—Muscles.

In order to ensure an intelligent study of hygiene, the science which deals with the preservation of health, it is necessary to know something about the body itself—of how it is built up, and the work that each part has to do. Work, either mental or muscular, is the chief object of our daily lives; this has to be carried on by one part of the body, called the "nervous system," or another part, called the "muscular system."

These systems, having to perform work for us, must be properly fed. The food, being prepared and supplied by the digestive and absorptive system, is carried to all parts of the body by the circulatory system, which in its turn is supplied with oxygen by the respiratory system, the waste matters produced being got rid of by the excretory system.

To understand the various organs of the body we must study a little *anatomy*, which concerns the structure of the various organs, and *physiology*, which is a study of their functions. If we examine any organ of the body under the microscope, we shall find it to consist of parts that differ from each other; these parts are known as various kinds of tissues.

On further examination of tissue, we find that it is built up of cells.

A human being commences life as a single cell, consisting of protoplasm, which contains a nucleus. When fertilised, this rapidly divides into numberless cells, which gradually arrange themselves into definite shapes and

positions to form the organs of the body—one kind of cell for the brain, one for muscle, another for skin. All these parts of the body have to be supported, and for this purpose we have connective-tissue cells, and bone cells, with which to form the skeleton, that gives to man his distinguishing shape or form.

Before considering the organs, an outline of the general build or arrangement of the body must be given. As far as possible, the special organs forming the various systems will be studied along with those sections of hygiene which are concerned with the health of the different parts or systems of the body. For example, the anatomy of the respiratory system and the circulatory or blood system will be described in association with ventilation; the skin and other excretory organs in connection with personal hygiene. But the student must first have a fair idea of the general build of the body.

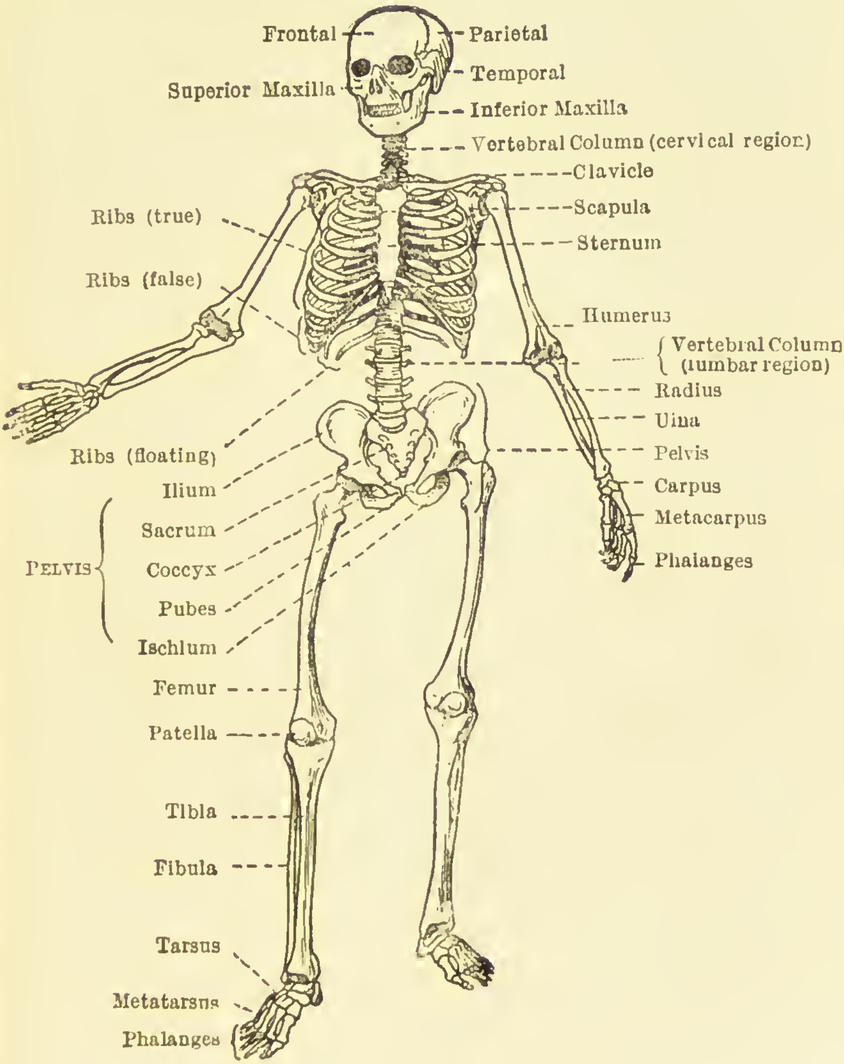
THE SKELETON.

The human body contains over two hundred bones, which are united to form a flexible skeleton, which gives definite structure to the body, allows free locomotion, and supports or protects the soft parts. The skeleton consists of the head or skull; the vertebral or spinal column and the ribs; the upper and lower limbs, which are attached to the rest of the skeleton by the pectoral and pelvic girdles respectively. The living bones consist of a hard material, composed chiefly of lime, and various soft parts—bloodvessels, nerves, fatty material, etc. In the centre of the long bones, for instance, we find the *marrow*, whilst the bone is covered on the surface by a membrane (*periosteum*), which is rich in bloodvessels, in order to ensure nourishment to the bone. Certain bones in the body, such as the ribs and vertebræ, contain no cavities, but consist simply of bony material, hard or *compact* on the surface, and honeycombed or *cancellous* in the centre.

THE SKULL OR BONES OF THE HEAD.

The bones of the head may be described under two headings—(1) The cranium, or brain-box; and (2) the bones of the face. All these bones are united firmly, except the lower jaw, which is movable.

The Cranium is composed of eight bones—one frontal, two parietal, two temporal, one occipital, one sphenoid, one ethmoid. The *frontal bone* forms the forehead and



THE SKELETON (FRONT VIEW).

the roof of the eye sockets. The *parietal bones* are two large bones on either side of the head, which meet each other above. The *occipital bone* lies at the back of the

head, and is pierced at its lower part by a large hole, the foramen magnum, through which the spinal cord is continuous with the brain. The *temporal bones* are situated at the sides of the head between the parietals above and the occipital bone behind. These bones contain the bony parts of the ear. The *sphenoid* and the *ethmoid bones* form the base of the cranium, and take part in the formation of the roof of the nose and the inner sides of the eye sockets. These eight bones provide a box in which the soft, easily injured brain lies protected. The edges of the bones of the cranium are serrated, like the teeth of a saw. In infancy these do not meet, thus allowing the bones to grow at their edges until the brain has attained its full size, when these edges come together, leaving a " suture " or seam between the different bones.

The Face consists of the following bones : 2 small *nasal* bones; 2 *inferior turbinate* bones in the nasal cavities; 2 *upper jaw* bones (superior maxilla); 2 *lachrymal* bones, small flat bones lying on the inner side of each orbit; 2 *malar* or cheek bones, which bound the orbits below and on the outer side; 2 *palate* bones, which lie behind each upper jaw bone, and take part in forming the hard palate; 1 *vomer* bone, placed vertically between the nasal cavities; and 1 *lower jaw* bone (inferior maxilla), a single bone which articulates with the temporal bone in front of the ear.

The Eye Sockets, or **Orbits,** are conical cavities, formed by various bones of the cranium and face. An opening can be seen at the apex of the cone behind where the optic nerve from the brain enters the eye socket.

The Nose Cavity is divided into two by a bony septum, the vomer. On the outer side of each passage the little *turbinate* bones can be seen.

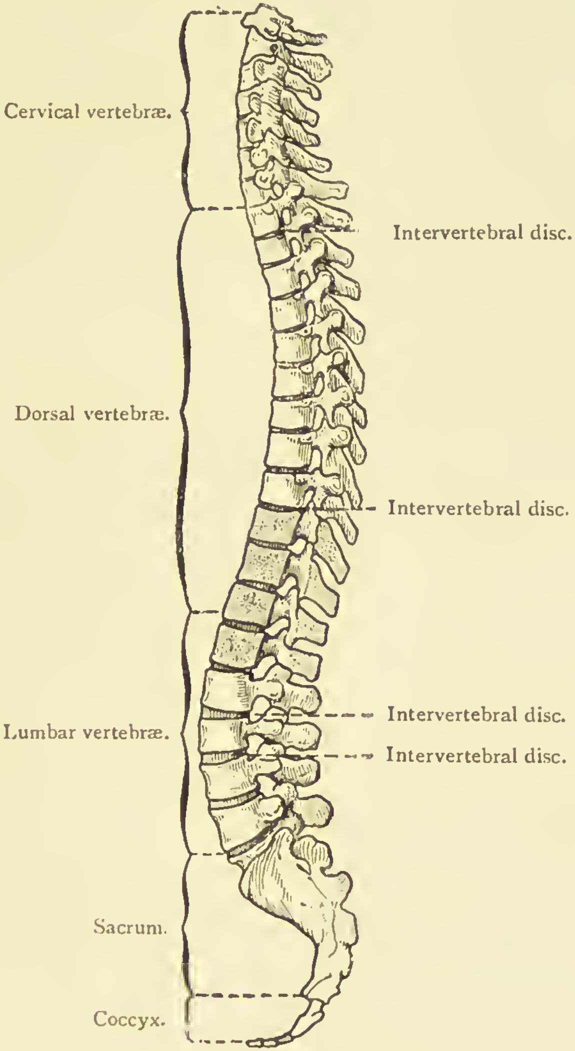
The Mouth shows the hard palate above and the sockets, containing the teeth.

SPINAL OR VERTEBRAL COLUMN.

The spine, or backbone, consists of a series of small bones, the vertebræ, thirty-three in number—seven cervical, twelve dorsal, five lumbar, five sacral, four coccygeal.

The Cervical vertebræ constitute the neck. The first supports the skull, and it is called the " atlas." At this

joint the nodding movements of the head take place. The side-to-side movements take place between the atlas and the second cervical vertebra, the axis.



THE VERTEBRAL COLUMN (SIDE VIEW).

The bodies of the 10th, 11th, 12th dorsal, and 1st lumbar vertebræ have been cut away to show the vertebral canal.

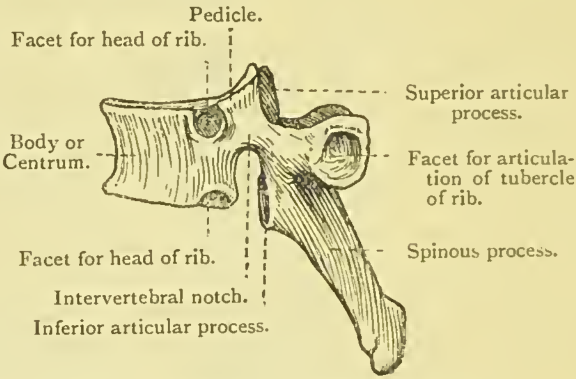
The Dorsal, or back region of the spinal column, contains twelve vertebræ, which support the ribs.

The Lumbar, or loin vertebræ, five in number, are larger, because they have to support a greater weight.

The Sacrum consists of five vertebræ, which become fused in the adult to form one bone.

The Coccyx, or tail, consists of four small vertebræ, which become fused in the adult.

It will be seen from the diagram that the spinal column is not straight, but takes the shape of four curves. It is curved slightly forwards in the neck, backward in the dorsum, and forwards in the lumbar region; whilst in the sacral and coccygeal regions there is a double curve, forming a concavity towards the pelvis, and a convex lump behind. These curves add to its flexibility, and avoid shock and jarring to the brain.



A Dorsal Vertebra (Side View).

Structure of a Vertebra.—Each vertebra consists of three parts—(1) The body, (2) the arches, (3) the three processes. The body helps to support the weight of the trunk. The long arch is attached to the back of the body. It encloses a space, which forms the *spinal canal,* in which lies the spinal cord. On either side of the arch of the vertebra transverse processes are seen, and behind there is a single spinous process which can be felt beneath the skin at the back. The powerful muscles for supporting the body are attached to these processes. The bodies of the vertebræ are united by a gristle-like material (cartilage), which forms a pad between each body to prevent shock and to

provide flexibility. These gristle pads are called *intervertebral discs.*

The Spinal Canal is a channel extending the length of the column, formed, as we have seen, by the processes from the bodies of the vertebræ, and it contains the spinal cord. This cord gives off thirty-one pairs of nerves, which pass from the canal by apertures between the vertebræ.

THE THORAX.

The thorax is a bony cage, bounded at the back by the twelve dorsal vertebræ, the hinder part of the ribs, with dorsal and intercostal muscles; at the sides by ribs and intercostal muscles; at the front by the front portions of the ribs, the costal cartilages, the sternum and the muscles lying between.

Above, the thorax is narrow, and closed by the first short pair of ribs, with the muscles and vessels at the root of the neck. Below it is wide, and has for its floor the diaphragm, passing upwards and inwards to a central tendon, forming an arched partition, convex above and concave below.

The Ribs.—There are twelve pairs of ribs, each pair being attached to a dorsal vertebra behind. The upper seven pairs reach from the back-bone to the sternum, and are called the *true* ribs. The remaining five pairs do not reach the middle line of the body, and are called *false* ribs; but they are attached through their cartilages to the sternum, except the last two pairs, which are called *floating* ribs. These last ribs are easily pressed out of place by badly fitting or tight stays.

The intervals between the ribs are called *intercostal spaces*, and they are closed in by the intercostal muscles.

The Sternum, or breast-bone, is dagger-shaped, with its broader upper end at the root of the neck, and its pointed cartilaginous end at the upper part of the abdomen. Attached on either side to the upper end of the sternum we have the clavicles, or collar-bones, and on either side of the shaft of the sternum the cartilages of the upper seven ribs are fixed.

THE UPPER LIMB.

Each upper limb consists of the following bones:

Pectoral girdle and upper-arm	Scapula. Clavicle. Humerus.
Forearm	Radius. Ulna.
Wrist and hand	8 carpal bones (wrist). 5 metacarpal bones (hand). 14 phalanges (fingers).

The Shoulder Bones.—The upper limb is supported and attached to the body by the shoulder, or *pectoral girdle,* which is composed of the scapula (shoulder-blade) and the clavicle (collar-bone).

The Scapula is a flat, triangular bone, lying on the upper ribs at the back of the chest on each side. A ridge or spine can be felt beneath the skin at the back of the shoulder. This can be traced forwards over the shoulder-joint as the *acromion process,* which forms the " tip of the shoulder." At the outer angle of the scapula towards the shoulder-joint a shallow smooth surface (glenoid fossa) receives the upper end of the arm bone (humerus), and forms the shoulder-joint.

The Clavicle, or collar-bone, is curved like the italic letter *f,* so that it is very elastic, and able to resist strain. The collar-bone is jointed in front to the sternum, and behind to the acromion process of the scapula. By drawing the finger along the collar-bone, it can be felt that the inner curve has its convexity directed forwards, whilst the outer curve has its convexity directed backwards.

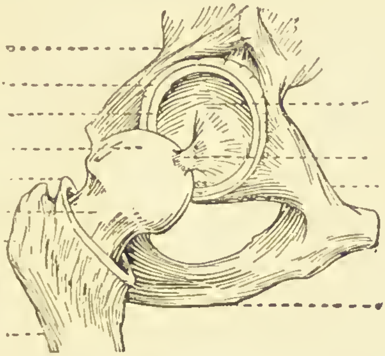
The Humerus.—The long arm-bone has a shaft, a head, which articulates with the scapula, and a lower flattened end, which articulates with the two bones of the forearm to form the elbow-joint.

The Forearm consists of the *radius,* or outer bone, extending to the thumb, and the *ulna,* or inner bone. The upper end of the ulna is enlarged to form the olecranon process, on which the bent elbow rests. The radius is small at its upper extremity, but it forms the principal part of the wrist-joint. In pronation—*i.e.*, turning the hand palm downwards—the lower end of the radius crosses the ulna

The Hand consists of the *carpus*, eight small bones arranged in two rows (the upper row articulates with the radius to form the wrist-joint); the *metacarpus*, five bones reaching from the carpus to the knuckles; and the *phalanges*. Each finger consists of three phalanges placed end to end, the joints of the fingers being made by their articulation with each other. The thumb has only two phalanges. The metacarpal bones and phalanges of the thumb lie rather obliquely, so man is able to bring the tip of the thumb in contact with the tip of each finger. This movement of "opposition" distinguishes man from the lower animals.

THE LOWER LIMB.

The Hip-Bones.—The sacrum supports on either side the large hip-bone. The hip-bones curve outwards and forwards to meet each other in front, thus enclosing the pelvic



HIP-JOINT (LAID OPEN).

cavity, and forming, with the sacrum and coccyx behind, the pelvic girdle. On the outer side of the large hip-bone can be seen a deep saucer-like cavity (acetabulum) for the head of the thigh-bone to form the hip-joint.

The bones of the leg are similar to those of the arm, consisting of—

Thigh ..	The femur (thigh-bone).
Lower leg ..	The patella (knee-cap). Tibia (shin-bone). Fibula (splint-bone, or brooch-bone).
Ankle and foot	7 tarsal bones (ankle). 5 metatarsal bones (instep). 14 phalanges (toes).

The femur, or thigh-bone, is the longest bone in the body. It consists of a head, which articulates with the hip-bone, a shaft, and a lower end, which forms part of the knee-joint. In front of this joint is the knee-cap, or **patella**. The leg below the knee has two bones—the **tibia** at the inner side, which supports the lower end of the femur (its sharp anterior border can be felt as the shin), and the **fibula**, or brooch-bone, which begins below the knee-joint, where it is attached to the tibia and passes down the outer side of the leg, to form the external malleolus, a bony prominence at the outer side of the ankle.

The Foot.—At the ankle there are seven bones, which form the tarsus, which articulate with the tibia and fibula to form the ankle-joint. The five long bones in the middle of the foot are called the " metatarsus," and they articulate with the phalanges or toes, which contain three bones each, except the big toe, which has only two.

THE JOINTS.

In connection with joints we find ligaments, which are tough bands or straps, which connect and bind the movable bones together, preventing them from being easily dislocated.

Ligaments, therefore, join bone to bone, while tendons join muscle to bone, and may be considered as a continuation of the muscle, being exceedingly strong, but flexible.

Joints are movable or immovable.

Immovable Joints show seams or cracks between the bones, which are dovetailed into each other in such a way that the power of movement is practically non-existent. The bones of the skull articulate in this way, whilst other bones (*i.e.*, the pelvis) may be separated by cartilage or gristle, which does not allow movement, but serves rather to prevent shock or strain.

Movable Joints.—When two bones meet to form a movable joint, their surfaces are covered by cartilage, which allows of smooth and free movements. The joint is further enclosed in a capsule, which contains synovial fluid secreted by the synovial membrane lining the capsule. This fluid oils or lubricates the joint. The capsule is strengthened by strong fibrous bands, which strap the bones together.

Some joints are called "ball-and-socket" (*e.g.*, the hip and shoulder joints), because they allow of more or less movement of a "universal" type. The hinge-joints (*e.g.*, the knee, ankle, elbow, and lower jaw) permit only hinge-like movements; whilst in the carpus and tarsus the movements are of a gliding description.

The Intervertebral Discs form joints between the vertebræ, as has already been mentioned.

A **Pivot Joint** is found between the atlas and axis, which permits side-to-side movements of the head to take place.

THE MUSCLES.

The joints themselves are immovable, all movements being performed by means of contraction of muscles. Muscle is flesh; a piece of steak or a slice of mutton is "muscle." This substance is made up of *fibres*, and each fibre under the microscope is seen to consist of bundles of finer fibres, which show dark stripes, and so these muscles are said to be *striated*. Each stripe marks the separation between the cells of which the fibre is composed. When a muscle contracts, the fibres swell, and the muscle is shortened. There are two classes of muscles—(1) Voluntary muscles, the fibres of which are striated or striped: (2) involuntary muscles, which is non-striated.

The Voluntary Muscles are under the control of the will. They have to do with the locomotion of the body. A voluntary muscle is generally attached to two bones, with a joint between. It may be attached directly to the bone, or by means of a tendon. The simplest forms of movement are flexion (bending) and extension. For example, if the hand is placed on the biceps muscle of the arm (which is attached to the scapula at the shoulder-joint, and to the radius below the elbow), and the elbow is bent, it can be felt that the muscle swells into a hard lump, as it contracts to bring about this movement. Other movements of the shoulder and hip joints are more complex, but they are all brought about by contraction and relaxation of muscles.

The Involuntary Muscles are found in the walls of the intestine, stomach, heart, bladder, bloodvessels. They act independently of the will, and they differ in structure

from voluntary muscle. They are not formed of fibres, but consist simply of muscle cells, spread as a coating to the tubes they enclose. The movement of these muscles are like those of a worm, and so they are called *vermicular* movements.

Heart Muscle, of which the heart is largely composed, differs both from striated and non-striated muscular tissue. Each fibre is a short quadrangular cell, showing faint transverse striations. The fibre cells are arranged end to end, having branches uniting with neighbouring cells, and are bound together in bundles by connective tissue.

CHAPTER II

THE BODY CAVITIES AND BODY SYSTEMS

Contents of thorax—The abdomen—The systems of the body—The tissues—The cells—The chemical composition of the body.

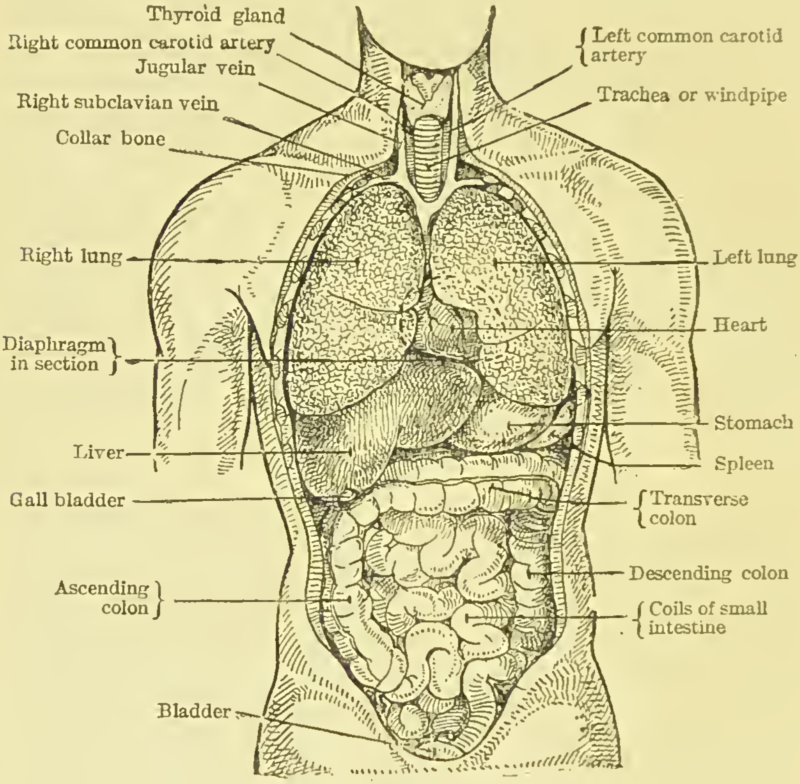
THE limbs may be described as solid structures, composed of bone, cartilage, and muscles, with their blood-vessels and nerves. The trunk, however, is hollow, and the skeleton, with its enclosing envelope, the skin, has to support the vital organs. The body is therefore divided into two cavities, the thorax or chest, above, and the abdomen below, by means of a muscular partition, the diaphragm.

CONTENTS OF THE THORAX.

The thorax contains the lungs, and the heart lying between them. Each lung is enclosed in a double sac, the *pleura*, a glistening membrane which envelops the lung and lines the chest wall. The two layers are in contact, and move smoothly against each other, because they are lubricated by a little fluid. In the centre of the thorax above can be seen the trachea, or windpipe, which divides into two bronchi, one going to each lung. The heart lies in a double membrane or sac, called the *pericardium*; and the thorax also contains the great vessels of the heart—the aorta, the pulmonary vessels, and the large veins. Other structures in the thorax include the œsophagus, or food-pipe, lying behind the trachea, or windpipe; the thoracic duct (carrying the lymph); and the lymphatic glands. The thorax is separated from the abdomen, as we have said, by a sheet of muscle, the diaphragm, which in inspiration extends downwards to enlarge the capacity of the chest.

THE ABDOMEN.

This cavity is bounded above by the diaphragm, in front by the strong abdominal muscles, which pass from the ribs to the pelvis. Behind are the lumbar vertebræ, the sacrum, the coccyx, and the muscles of the back; whilst below the abdomen is bounded by the pelvic bones. Just as the thorax is lined by a glistening membrane—the pleura—so



Contents of Thorax and Abdomen.

the abdomen is lined with *peritoneum*, a smooth, moist membrane, which also covers the organs in the abdominal cavity. These are the stomach, intestines, pancreas, spleen, liver, kidneys, and bladder. The stomach communicates above with the œsophagus, and below with the *small intestine*, a coiled tube which terminates at the lower right-hand corner of the abdomen as it enters the large intestine.

The *large intestine* passes up the right side, across the abdomen just below the stomach, and down the left side to terminate in the lower bowel. The *liver* is a large gland on the upper right side of the abdomen. The *pancreas*, or sweetbread, lies in the bend of the duodenum. The *spleen* is a small, dark-coloured gland lying to the left of the stomach and pancreas. The *kidneys* are placed against the backbone in the lumbar region. The *ureters* are two tubes leading from the kidneys to the bladder. The *bladder* lies rather in the *pelvic cavity*, which contains also the organs of *reproduction*.

THE SYSTEMS OF THE BODY.

The body is composed of different systems. Each *system* has a special function—for example, the digestion of food—and is made up of organs specially constructed to promote the function of the system of which they form a part. The chief systems are—

1. **The Alimentary** or **Digestive System,** composed of the stomach, intestines and various glands. This system is concerned with the digestion of food, which has to be altered so that it may be absorbed into the blood.

2. **The Circulatory System** has to do with supplying the blood which nourishes the tissues to every part of the body. Its organs are the heart, arteries, capillaries, and veins.

3. **The Respiratory System** is concerned with supplying the tissues and cells with oxygen, which is essential to their vitality, by means of the lungs, the organs in which the blood is purified, aerated, or supplied with fresh oxygen.

4. **The Muscular System** has to do with the movements or locomotion of the body.

5. **The Osseous** or **Bony System** or skeleton supports the soft parts.

6. **The Excretory System,** the chief organs of which are the lungs, kidneys, and skin, eliminates or gets rid of impurities from the blood.

7. **The Lymphatic System** consists of glands and lymphatics, containing 'lymph, which' also lies in spaces in the tissues. Lymph escapes through the thin walls of the

bloodvessels, carrying food for the nourishment of the tissues, and removes waste materials from the tissues, being conveyed by the lymphatics to the thoracic duct, thence to the large veins entering the right auricle.

8. **The Nervous System** controls every other system of the body, and is also the centre of "will," consciousness, and the higher attributes of the mind. The organs belonging to this system are the brain, spinal cord, and the nerves.

The Tissues.—Now, the organs of the different systems are in their turn composed of materials called *tissues*. Tissue is the name given to particular types of cells uniting to perform a definite function.

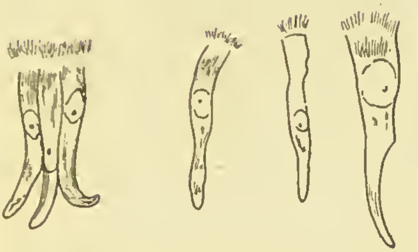
Connective Tissue.—If a piece of beef or mutton is dissected with a fine knife or needle, it can be seen that the muscular fibres are held together by a glistening white material. This is connective tissue, so called because it connects or holds together other tissues in the body. It forms a sheath round the muscles, and connects the skin with the structures underlying it. It is found round the bloodvessels, and acts as a framework for all the organs. Microscopically, it is made up of bundles of white wavy fibres, with a few yellow elastic fibres, and certain branching cells or connective-tissue corpuscles.

Epithelial Tissue consists of a layer of smooth cells. This tissue lines the various tubes of the body, the bloodvessels, the digestive tube, the respiratory passages, etc Various types of epithelial tissue are—Columnar epithelium (column cells), striated epithelium, and ciliated epithelium (where the cells have little hair-like processes).

Adipose Tissue, or fatty tissue, consists of cells held together by connective tissue, each cell containing a drop of liquid fat or oil globule.

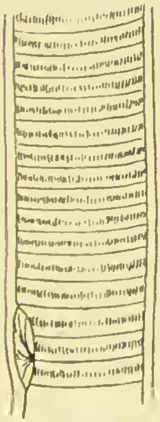
Muscle Tissue, as we have said, consists of fibres (voluntary muscles), or cells with connective tissue between them (involuntary muscles).

Cartilage is the material which covers the ends of bones, where they articulate one with another. Microscopically, it shows a clear substance or matrix with cells embedded in it. This type of cartilage is called *hyaline cartilage*, and it forms also the rib cartilages, the rings of the trachea and bronchi, and part of the larynx, or organ of voice, and it invests the ends of bones at the joints.



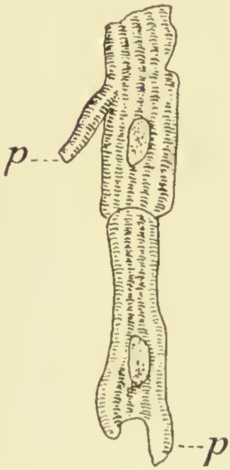
Columnar Ciliated Epithelium from the Nasal Passages.

Epithelial Tissue.



Striated Muscle Fibre (Highly Magnified).

A nucleus is seen at the lower end of the left side.



Two Cardiac Muscle Fibres.

Two nuclei are seen.
p, Processes which join other fibres.

Cartilage forming the intervertebral discs contains fibres, and is called white fibrous cartilage.

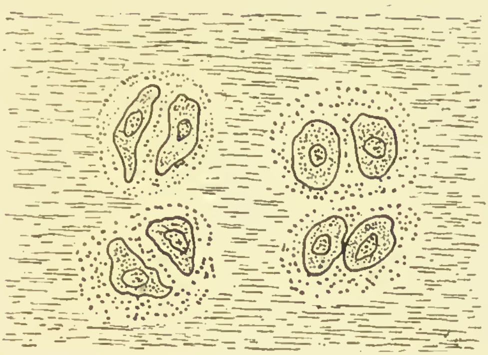
In other cartilages—for example, the ear cartilage—yellow elastic fibres are found in the matrix, and so this type of cartilage is called yellow elastic cartilage.

Bone.—The microscopic structure of bone tissue consists of tiny channels or canals (the Haversian canals), surrounded by concentric rings, which are marked out by spaces, the lacunæ. In the lacunæ, bone cells can be seen which are branched. Small bloodvessels traverse the canals, which supply nourishment to the bone. Bone consists of animal matter or organic matter (about 33 per cent.) and mineral salts (about 67 per cent.), which impart rigidity to the bone.

Nerve Tissue is made up, as we shall see, of nerve cells and nerve fibres. Nerve cells have a highly specialised function. They are found, for instance, on the surface of the brain, and each nerve cell shows branching processes, one process being continued into a nerve fibre.

Most of the organs contain several kinds of tissues. The stomach, for instance, is lined with epithelial tissue. It has muscular tissue in its walls, also gland tissue, nerves, bloodvessels, etc. If a tissue is examined under the microscope, it is found to be made up of *cells*. The different tissues have different varieties of cells, which can quite easily be distinguished under the microscope. The human body is therefore made up of cells—millions of cells—which are constantly changing. We know that the surface cells of the skin are daily shed as scurf, and that these lost cells are made up by new cells formed in the deeper layers of the skin. Each living cell is composed of a substance called *protoplasm*, which Professor Huxley defined as "the physical basis of life." A cell is a mass of protoplasm containing a nucleus which is a more highly specialised area, and the cells may measure perhaps $\frac{1}{2000}$ inch, some being smaller than this, and some larger.

The Chemical Composition of the Body.—The organs, the tissues, and the cells, are made up of various chemical compounds, some being organic, and some inorganic or mineral, such as water (70 per cent. of the body-weight), sodium chloride or common salt, lime salts (in the bones and teeth). The organic substances contain oxygen, hydrogen,



Hyaline Cartilage (Highly Magnified).
The nucleated cartilage cells are seen embedded in the matrix.

Transverse Section of Compact Bone Tissue.
Three Haversian canals are seen with their concentric rings.

nitrogen, carbon, and sulphur. Examples of organic compounds are sugar, protein (albumin or white of egg, for instance), and fat. In all living tissues a process which we can compare to combustion is constantly taking place. The oxygen, which is taken into the body by respiration, enters into chemical union with substances in the tissues, so that heat is produced, just as in the case of burning coal or wood. In ordinary combustion, various gases, including carbonic acid gas, are formed and pass into the air, as the material burnt is destroyed. In the same way, when oxidation or combustion takes place in the body, carbonic acid gas is given off and excreted by the lungs. Water containing other waste products is also eliminated by the lungs and skin, the kidneys and bowel. The various chemical elements present in the body are obtained from the oxygen inspired, and from the food and drink consumed. The description of these various processes brings us to physiology and hygiene. Sufficient information concerning the elementary anatomy of the body has been given to make an intelligent consideration of the general subject of physiology and hygiene less difficult. The anatomy of the digestive, respiratory, and excretory systems will be considered under their different sections.

CHAPTER III

THE ORGANS OF DIGESTION

The mouth and teeth—The salivary glands—Digestion in the mouth —The œsophagus, the pathway leading to the stomach.

PERHAPS the most important of all bodily functions, if it be permitted to compare the relative value of the vital processes, is concerned with nutrition. We must eat to live. We must choose wisely such foods as best meet the needs of the body in its constant expenditure of energy, such foods as are easily digested and readily absorbed.

Nutrition is the process by which food is taken into the body, rendered soluble in the digestive canal, absorbed into the blood, and carried to the tissues. The living tissues are bathed in a fluid lymph which oozes through the blood-vessel walls, and which supplies the cells with nutritive matter and oxygen. The nutritive matter is derived from the food we eat; the part which oxygen plays in nutrition will be considered later. It can be readily understood that before food—meat, vegetable, sugar, etc.—can be converted into the constituents of the blood, it must be subjected to various chemical and physical processes in the digestive or *alimentary* canal.

The food is broken down in the mouth, mixed with a digestive juice—*saliva*—swallowed, and propelled along the alimentary canal, where it is acted upon by other fluids—the gastric juice and intestinal juice, the pancreatic juice, and the bile. These fluids, as we shall see, make the solid food soluble, so that it can pass through living membranes. Thus food material is *absorbed*, and the blood is provided with new supplies of nutritive material at regular intervals.

Imagine the digestive system as a long tube which varies in shape and circumference at different parts. The tube begins with the mouth, passes, as the long narrow *œsophagus*

or gullet, down the chest to pierce the diaphragm and enter the abdomen. There it immediately expands into a bag—the *stomach*—which bulges at the left side of the body, and narrows as it passes towards the right to become a tube again. This tube is now called the *intestine,* and it is very long in order to allow ample surface for digesting and absorbing the food. Therefore it has to lie coiled in the body. Indeed, the first part, the *small intestine,* which is narrower and smaller in circumference than the large intestine, is over 20 feet long. The *large intestine* measures about 6 feet in length. The digestive tube terminates in the lower bowel or rectum, from which undigested food material is expelled from the body.

The whole alimentary canal is lined with mucous membrane—a thin, soft, moist " inner skin," as it were—which can be seen on the inner aspect of the lips. On the surface of the membrane are the openings of innumerable tiny glands, which secrete mucus, a fluid which keeps the surface of the digestive tract moist.

The Mouth.—The cavity of the mouth and tongue are lined with this membrane. The tongue, which helps the teeth to break up the food, is composed of strong muscle tissue, and its surface is covered with numerous small projections or villi.

The roof of the mouth is formed by the *hard palate* in front and the *soft palate* behind, which terminates in the centre in a little tongue-like process, the *uvula.* The mouth is continued backwards into the *pharynx,* and the tonsils can be seen, one on either side, whilst the *epiglottis* is a little flap of cartilage at the root of the tongue which covers the opening to the windpipe during the act of swallowing food.

The Teeth, which play such an important part in masticating the food, in biting and tearing and grinding it to a soft mass or " bolus," are arranged in sockets in the upper and the lower jaws. There are four types of teeth. In front are the *incisors*—flat, sharp, biting teeth. On either side are narrow, fang-like teeth called *canines.* Behind the canines are the *bicuspids,* which have a double fang in the jaw, and which also appear to be partly split into two on the crown. The *molars* are broad-crowned grinding teeth at the back of the jaw. Each tooth consists of a crown, a neck, and one or more fangs which constitute the

root. The material of the tooth is called *dentine*, a hard substance enclosing a hollow cavity filled with soft *pulp*, made up of nerve fibres and tiny bloodvessels, which enter the teeth at the tip of each fang. Inflammation of this pulp causes toothache. The crown of the tooth is covered with a layer of *enamel*, a substance harder than bone. The fang of the tooth is covered with a bony layer of *cement*, which fixes the root securely in the bony socket. At the junction of the crown and root is a slight constriction, which is called the *neck*, and it is here that decay frequently begins.

There are two sets of teeth, the first set being called the *temporary* or milk teeth, and the second set the *permanent* teeth. The twenty milk teeth are arranged in the jaw as follows:

	T.M.	C.	I.	I.	C.	T.M.	
Upper	2	1	2	2	1	2	= 10
Lower	2	1	2	2	1	2	= 10
				Total temporary ..			20

The thirty-two permanent teeth being—

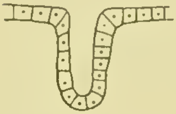
	Mol.	Bicusp.	Can.	Incis.	Incis.	Can.	Bicusp.	Mol.	
Upper jaw	3	2	1	2	2	1	2	3	= 16
Lower jaw	3	2	1	2	2	1	2	3	= 16
					Total permanent ..				32

Milk teeth appear at the following ages: Lower central incisors, sixth month; upper incisors, eighth to tenth month; lower lateral incisors, twelfth month; first molars, thirteenth to fifteenth month; canines, eighteenth month; second molars, twenty-second to thirtieth month.

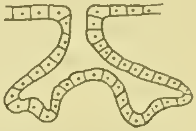
The permanent set begin to appear at six years of age in the following order: First molars, six years; central incisors, seven years; lateral incisors, eight years; first bicuspids, nine years; second bicuspids, ten years; canines, twelve years; second molars, fourteen years; third molars (wisdom teeth), sixteen to twenty-five years.

Decay of the teeth is caused by the presence of bacteria which produce acid *fermentation*. Decay quickly spreads from one tooth to another, and rapidly penetrates into the interior of the tooth when once the enamel has been cracked or broken, as dentine is less hard and less resistant than enamel.

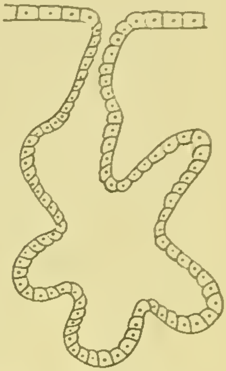
The Salivary Glands.—We have already mentioned that the food is mixed with a substance called *saliva*. This is a digestive fluid which is secreted by three pairs of salivary



SIMPLE TUBULAR GLAND.



BRANCHING GLAND WITH DUCT.

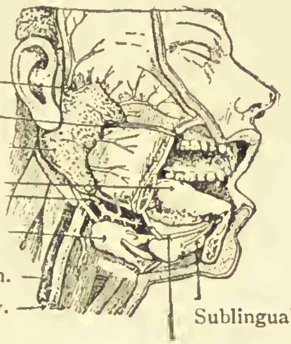


SECTION OF SAC OF COMPOUND BRANCHING GLAND, SALIVARY GLAND, OR PANCREAS.

glands. The *parotid glands* are the largest, and are situated one on each side of the face, in front of and below the ear, and their ducts open into the mouth opposite the second upper molar tooth on either side. The *submaxillary glands* are situated under the lower jaw on either side, and the two *sublingual glands* lie under the tongue. Their ducts open into the floor of the mouth under the tongue. These glands are made up of cells which have the power of secreting a fluid, which they discharge into a small tube or duct which opens into the mouth. This tube passes backwards from the mouth towards the gland, branching as it approaches the gland like a tree, and each branch tube expands into a tiny sac lined with cells. These little sacs are held together by connective tissue, in which there is a dense network of small bloodvessels. The cells in the gland have the power of extracting material from the blood and converting it into saliva, which they pour into the duct which conveys it to the mouth. The sight or smell or taste of food stimulates these glands, and the mouth " waters."

Saliva is a clear watery fluid, alkaline in reaction, containing a ferment called " ptyaline." A *ferment* is an organic substance, which has the power of producing a chemical change without undergoing any change itself. In this case ptyaline converts an insoluble carbohydrate, starch, into a soluble carbohydrate, sugar, because it causes the starch to unite with water. If a piece of bread is chewed for some time in the mouth, it gradually becomes sweet, because the starch, as a result of being mixed for

some time with the saliva, has been converted into sugar. If saliva is boiled, it loses this power of converting starch into sugar, because ptyaline ferment is destroyed by boiling. The saliva of young infants contains very little ptyaline, and for this reason babies ought not to be given starchy foods, such as rusks or bread, for the first eight or nine months. About 2 pints of saliva are poured into the mouth from the ducts of the salivary glands every twenty-four hours. Saliva also moistens the food, thus assisting *mastication*, especially if the food is very dry. Digestion *begins in the mouth*, and without thorough chewing the saliva has not time to act properly upon starch. Secondly, thorough mastication is necessary, because if the food is not broken down as it ought to be by the teeth, but swallowed in lumps, the stomach is overworked. Bolting the food is



FACE DISSECTED TO SHOW THE MOUTH AND SALIVARY GLANDS.

the commonest cause of indigestion. After the food has been crushed into pulp by the teeth and mixed with the saliva, it is moulded into a "bolus," which is passed into the *pharynx*, a muscular bag extending from the base of the skull to the œsophagus, the pharynx being common to both the alimentary and respiratory tracts. The *œsophagus*, or gullet, is a soft muscular tube or passage about 10 inches long leading to the stomach.

The food or drink does not flow down the gullet as it would down a pipe. Normally the gullet or œsophagus lies flat at the back of the trachea; when a bolus of food is passed to the entrance of the œsophagus, the circular muscles behind the bolus contract, forcing it onwards by a continuous wave of contraction towards the stomach.

CHAPTER IV

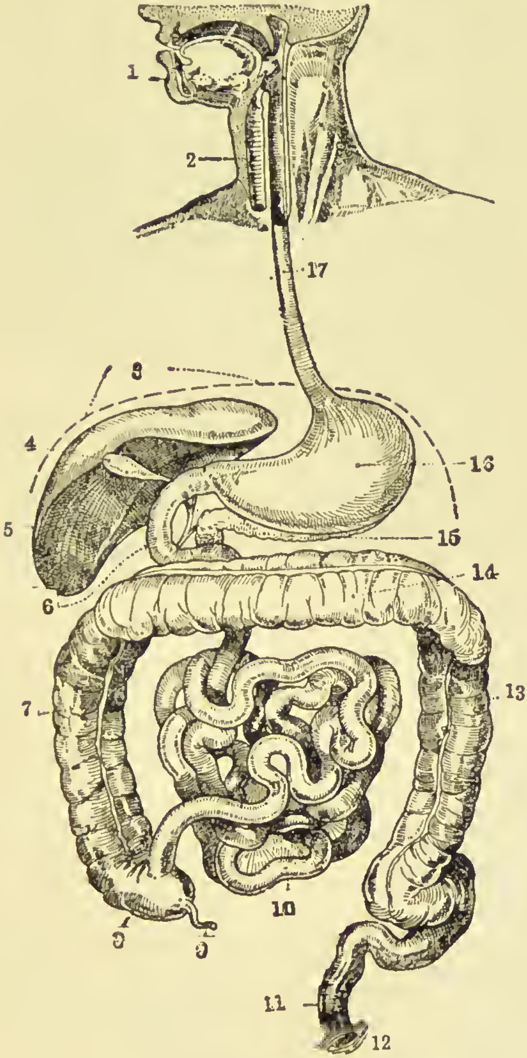
THE ORGANS OF DIGESTION—*Continued*

The stomach and gastric juice—The small intestine and its digestive juices—The pancreas and the liver—Absorption—The large intestine.

The Stomach is a J-shaped organ lying in the abdomen, just below the diaphragm. It measures about 10 inches from left to right, and 4 to 5 inches in depth. The upper border is concave, and is therefore called the *lesser curvature*, the lower convex border being called the *greater curvature*. The junction of the œsophagus and stomach is called the *cardiac* end of the stomach, whilst at the *pyloric* end the stomach is continuous with the duodenum, the first part of the small intestine. The stomach is in reality a muscular bag, its walls being formed of three layers—(1) The mucous membrane; (2) the muscular coat; (3) the serous coat.

The mucous membrane is reddish-grey in colour. It is thrown into ridges and folds, as the stomach gets empty and contracts, but it is quite smooth when the organ is distended. The membrane is richly supplied with tubular glands, which are lined with cubical cells, with an occasional dark round or ovoid cell at the cardiac end of the stomach. Between these glands is *connective tissue* containing bloodvessels and lymphatic vessels, and during digestion these bloodvessels are dilated and filled with blood. The gland cells have the power of abstracting material from the blood and utilising it to "secrete" gastric juice.

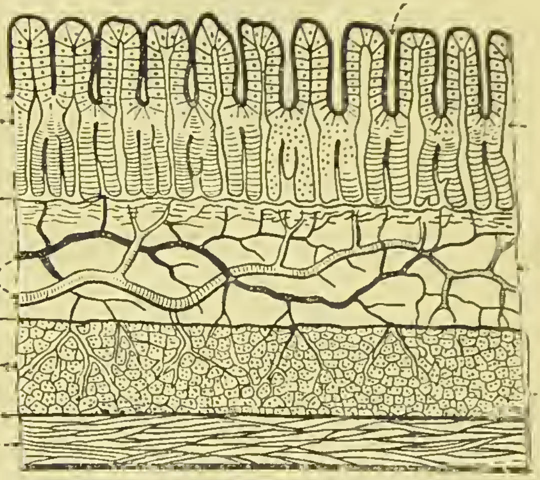
The muscular coat is divided into three layers. In the inner layer the fibres are arranged obliquely, in the middle they are circular, and in the outer layer longitudinal. The contraction of these muscles produce rotatory movements



Alimentary Tract.

1, Salivary glands on each side; 2, trachea, or windpipe; 3, line of diaphragm; 4, gall-bladder; 5, liver; 6, the duodenum; 7, ascending colon; 8, cæcum; 9, vermiform appendix; 10, small intestine; 11, rectum; 12, anus; 13, descending colon; 14, transverse colon; 15, pancreas; 16, stomach; 17, œsophagus.

of the stomach, so that the food is churned, as it were, being broken down to be mixed with the gastric juice and partially digested.



COATS OF THE STOMACH (MAGNIFIED).

The outer or serous coat of the stomach is a smooth, glistening membrane, which covers or envelops all the organs and lines the cavity of the abdomen. This membrane is called the *peritoneum,* or peritoneal membrane.

Gastric Juice is a clear, colourless, acid liquid, about 10 to 20 pints of which are secreted per day by the tubular glands in the walls of the stomach. It contains a ferment called *pepsine* and a small quantity of *hydrochloric acid* (about 2 parts per 1,000), and these substances have the power of converting the insoluble proteins of the food into *peptones.* Another ferment, *rennin,* in the gastric juice curdles milk. As the gastric juice is acid, it arrests the action of the swallowed saliva on starch, because the alkaline ptyaline is destroyed by acids.

There are two kinds of glands at the cardiac end of the stomach: one secretes the HCl, and the other the pepsin; while at the pyloric end we have only the pepsin-producing cells, so that the food has its supply of acid on entering the stomach. The only action upon fats in the stomach is to dissolve the protein envelope of some of them, thus setting the fat globules free.

In the course of two or three hours the contents of the stomach, under the influence of warmth and movement and the action of the gastric juice are reduced to a semi-liquid matter called *chyme*. This consists of various salts, of water, of sugar which has been obtained by the action of the saliva, of undigested starch, of fatty material, of proteins which have not been digested, of soluble peptones derived from digested proteins. A certain amount of absorption of water, sugar, and peptones takes place in the stomach, but most of the food or chyme passes through the pyloric opening of the stomach into the small intestine. The pylorus remains closed during stomach digestion—hence the name "pylorus," gate-keeper.

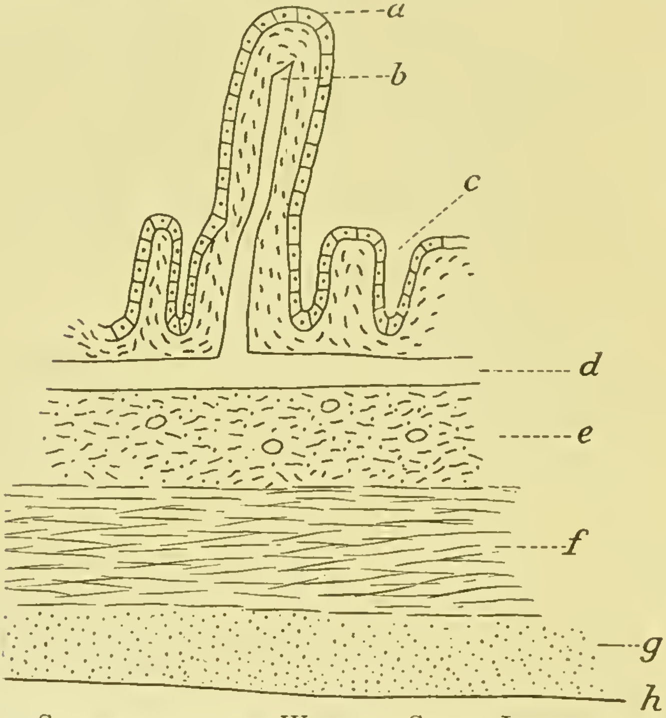
THE SMALL INTESTINE

is a tube about 20 feet long, which lies coiled up in the centre of the abdomen. It is divided for descriptive purposes into three parts—the duodenum (10 inches long), the jejunum (8 feet long), and the ileum (12 feet long). Like the stomach, its walls consist of—(1) Mucous membrane; (2) muscular coat; (3) serous coat, or peritoneum.

The mucous membrane is thrown into deep folds, the *valvulæ conniventes*, which delays the passage of food, and increases the area of surface for secretion and absorption. If the finger is drawn over the mucous membrane, it feels exactly like a velvet pile, because it is covered or studded with tiny projections called *villi*. Between the villi are the openings of tubular glands, which secrete intestinal juice. In the region of the ileum oval-shaped patches of cells can be seen. These are called "Peyer's patches," and they are inflamed in typhoid or enteric fever.

The Villus plays a very important part in the absorption of food. If looked at under the microscope, it can be seen that it is covered with a layer of column-like, or columnar, cells, and that it contains a tiny artery and vein in its centre, and an irregular space called a *lacteal*. The lacteal is so called because during digestion it contains a milky fluid (*lactus* = milk), and it communicates with a tiny lymphatic vessel in the connective tissue. The bloodvessels in the villi have the power, which is almost a selective action, of absorbing such substances as peptones and sugars, whilst the lacteals take up the *fat* and pass it to

the lymphatic vessels. But before food can be absorbed by the villi, it has to be acted upon by the various juices or secretions of the small intestine—namely, the pancreatic juice, the bile, and the intestinal juice.



SECTION THROUGH WALL OF SMALL INTESTINE.

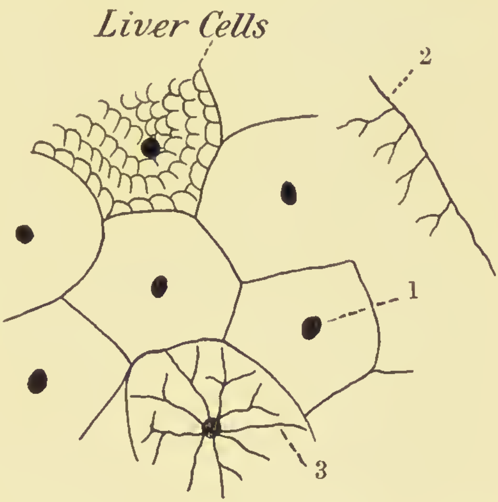
a, Villus ; *b*, lacteal ; *c*, tubular intestinal gland ; *d*, lymphatic vessel; *e*, connective tissue; *f*, muscular coat; *g*, muscular coat; *h*, serous coat, or peritoneum.

The Pancreatic Juice is a very important digestive fluid secreted by the *pancreas*, or sweetbread, a gland with a structure like the salivary glands, which lies below and behind the stomach. This juice has a threefold action, because it contains three ferments. About ¾ pint is secreted per day.

(1) It contains a ferment which "emulsifies" fat—that is, it breaks large globules of fat into tiny globules, so small that they can be absorbed by the villi. (2) It contains a ferment like ptyaline, which converts starch into sugar. (3) The third ferment converts proteins into peptones.

THE LIVER.

The Bile is secreted by the *liver*, the largest gland in the body. It weighs about 50 ounces, and is situated at the right side of the abdomen. The liver is dark red in colour, and covered with peritoneum. It is divided into two lobes by a deep cleft on its under surface, called the *portal fissure*. The larger right lobe is again divided into three lobes, and the left one into two. At the portal fissure can be seen five large vessels—the *hepatic artery*, which supplies the liver with arterial blood; the *portal vein*, which brings blood containing nutriment derived from the stomach and intestines as a result of digestion; two *hepatic veins* and the *bile duct*, which conveys the bile *from* the liver to the duodenum. To get an idea of the structure of the liver, think of the great lobes as being made up of tiny lobules about the size of a pin's head. Each lobule consists of a group of cells, around which runs a branch of the hepatic artery, of the portal vein and of the bile duct. The blood-vessels, hepatic artery, and portal veins give off tiny capillaries, which run inwards to join a vein in the centre of the lobule, called the *intralobular vein*, where the arterial and portal blood mix, collecting together, with others, to form sublobular veins, which join to form the *hepatic vein*, which carries the venous blood from the liver to the inferior vena cava just below the diaphragm.



SECTION OF LOBULE, SHOWING SECTION OF—

1, Intralobular vein in centre of each lobule; 2, branch of bile duct; 3, branch of hepatic vein.

The bile, secreted by the liver cells, enters the little vessels or ducts between the lobules, which join with other ducts to form ultimately one large duct conveying bile from

the liver. The bile is stored until required in the **Gall-bladder,** which lies on the under surface of the liver, but during digestion the bile passes to the duodenum. The bile ducts join the pancreatic duct, and they open together into the intestine. The liver secretes about 2 pints of bile a day, a golden-brown fluid which has the power of emulsifying fats. The liver has other functions besides (1) forming bile. (2) It acts as a storehouse for *glycogen,* a starch-like substance, which is derived from the sugar, conveyed by the portal vein from the intestines to the liver. This glycogen is changed again to sugar when required by the body. (3) It forms urea, which is afterwards excreted by the kidneys. (4) It destroys worn-out red corpuscles. (5) It arrests poisonous and deleterious materials in the blood.

ABSORPTION.

After the food has been acted upon by the digestive juices in the small intestine, it is changed into a milky fluid called "chyle," and a thick residue or waste material. The food passes along the small intestine, bathing the little villi on its surface. The cells in the villi absorb the liquid which passes through their walls to the tiny bloodvessels and lacteals. The bloodvessels absorb the sugars and peptones, which pass ultimately by the portal vein to the liver, whilst the lacteals take up the fat and convey it to the little lymphatic vessels in the connective tissue of the intestinal wall. These lymphatic or lacteal vessels join together one with another, until they open into a large vessel called the *thoracic duct,* which passes up the chest to open into a large vein at the root of the neck. Thus the fat ultimately enters the blood. The residue, which is composed of indigestible and waste material, passes along the intestine. At the termination of the small intestine we find the *ileo-cæcal valve,* a double fold of mucous membrane which allows the food to pass into the large intestine, but prevents it from passing in the reverse direction.

THE LARGE INTESTINE

is wider in diameter than the small intestine, and it is about 6 feet long. The first part is dilated and saclike, and is called the *cæcum,* and from this the *vermiform appendix,* a wormlike process, extends downwards. The

cæcum lies in the right side of the abdomen, and the large intestine passes upwards in the right side as the *ascending colon* to the under surface of the liver. It then crosses as the *transverse colon* to the left side, and passes downwards as the *descending colon.* The tube now bends like an **S**, and so this part is called the *sigmoid flexure.* The intestine terminates in the *rectum,* or lower bowel, which opens externally at the anus (see diagram, p. 27). Like the small intestine, the large intestine has three coats. The mucous membrane is smooth, and has no villi, but it containsa number of tubular glands which secrete the intestinal juice. The muscular coat is arranged in three longitudinal bands, and as these muscular bands are shorter than the rest of the wall, the large intestine looks puckered. The serous coat forms part of the peritoneum. In the large intestine a certain amount of absorption still goes on, whilst the undigested residue gradually becomes more solid and is expelled from the body.

Food.	Digestive Fluid.	Where acted upon.	Products of Digestion.
Starch (cooked) ..	Saliva.	Mouth.	Sugar.
	Ptyalin swallowed.	Stomach.	Sugar.
	Pancreatic juice.	Small intestine.	Sugar.
Cane-sugar ..	Intestinal juice.	Small intestine.	Sugar.
Proteins ..	Gastric juice.	Stomach.	Peptones.
	Pancreatic juice.	Small intestine.	Peptones.
Fats and oils..	Digestive juice of stomach.	Stomach (digests protein envelope).	Emulsion of fat (fatty acid and glycerine and soap).
	Bile and pancreatic juice.	Small intestine.	
Mineral salts..	Dissolved in the	water.	

CHAPTER V

THE HEART AND BLOODVESSELS

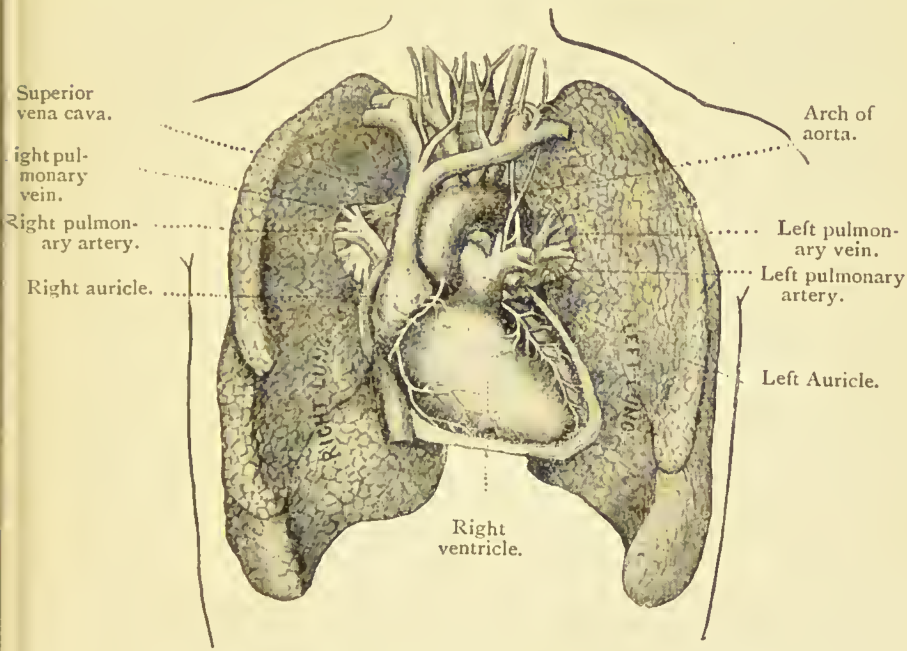
The heart—The arteries—The pulse—The capillaries—The veins—The circulation of blood.

THE blood, the nutrient fluid of the body, is contained in a series of closed tubes, through which it circulates continually, propelled by the heart's action. The heart may be compared to a muscular double pump, which is so constructed as to force the blood in a particular direction. The blood flows from the heart through the arteries, which break into tiny branches in every tissue and organ. In these small branches (capillaries) the blood gives up oxygen and receives carbonic acid gas, when it becomes *venous blood,* which is returned to the heart by the veins.

THE HEART.

The heart is the central organ of the blood system. It lies in the thorax, enclosed in a membrane (the pericardium) between the two lungs. Three-quarters of the bulk of the heart lies to the left side. It is a hollow muscular organ divided by a medium partition, so that there is no communication between the right and the left side of the heart. This is an important fact to remember. The right side is further divided into a right auricle above and a right ventricle below, the left side having a left auricle above and a left ventricle below. A sheep's heart or a bullock's heart should be obtained and examined. The organ is seen to be conical in shape, with a broad base above and an apex at the lower end. At the front of the heart a fairly deep groove filled with fat can be seen. This marks the division of the heart into right and left side, or right and left ventricle. On the under surface of the heart a less

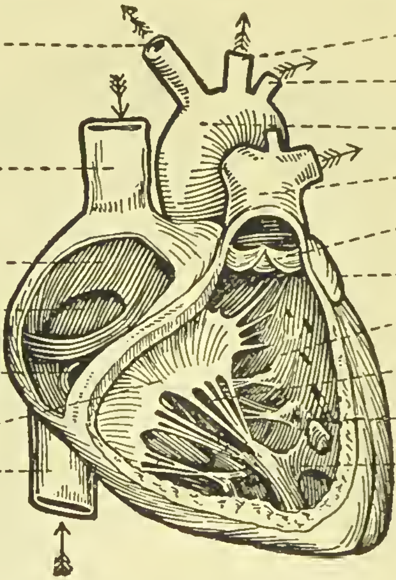
well-marked groove may be seen, and this aspect of the organ is much flatter. At the base of the heart the right and left auricles are situated. Their walls are thinner and softer than the ventricles. But the left ventricle and auricle have walls three times as thick as the right ventricle and auricle respectively, because the blood from the right side of the heart has only to be propelled through the lungs, the blood from the left side has to be forced through the whole body, as we shall later see. If the right *auricle* is



HEART AND LUNGS.

examined, two large veins can be seen entering it. At the upper part, the superior vena cava conveys venous blood from the upper part of the body—the head, neck, and the upper limbs—to the right auricle. At the lower aspect of the right auricle another large vein, the inferior vena cava, enters, conveying the blood from the lower part of the body and the lower limbs. When the right auricle is distended with blood, it contracts and forces the blood through an opening into the *right ventricle*. This opening is guarded by the *tricuspid valve*, so called because it has

three flaps or cusps which close when the ventricle is full of blood and begins to contract. This prevents the blood regurgitating or passing backwards to the auricle. It is forced onwards through a large artery—the pulmonary artery—to the lungs. This artery divides into two branches, right and left pulmonary arteries, for the right and left lungs. When these branches reach the lungs, they divide and subdivide into smaller and smaller branches until they end in capillaries (*capillus* = a hair), vessels so small and so constructed that gases can pass through their



RIGHT SIDE OF THE HEART (LAID OPEN).

The arrows indicate the direction in which the blood flows.

walls. Thus the blood receives oxygen from the lungs and gives up carbonic acid gas, which is expired and breathed out from the lungs (see p. 49). The blood is consequently changed from dark blue venous blood to red or arterial blood, and is conveyed from the lungs by the pulmonary veins to the *left auricle*. This cavity when distended contracts, and the blood passes to the *left ventricle*. Between the left auricle and left ventricle is situated the mitral valve, which has two cusps or valves, and which closes when the ventricle contracts, so that no

blood can pass back to the auricle. It is forced onwards to the *aorta*, the largest bloodvessel in the body, which gives off branches to all parts of the body. The opening to the aorta is also guarded by valves (the semilunar valves), which prevent the blood returning to the heart. It can thus be seen that there are really two hearts lying in contact with a partition between them. The right side of the heart, or right heart, receives venous blood, and sends it through the lungs. The left side of the heart, or left heart, receives arterial blood from the lungs, and sends it through the body. The heart is lined by a smooth membrane (endocardium), and the valves are really folds of this membrane. When the blood contains the poisons of infectious fevers (scarlet fever, rheumatism, etc.), inflammation of the endocardium may result, also inflammation of the valves, which are afterwards impaired in function, producing " valvular disease of the heart."

The Heart-Beat is produced by the contraction of the muscular walls of the various chambers. First the two auricles contract and force the blood into their respective ventricles, the ventricles in turn contract, and at the same time the doors into the auricles are closed by the valves. When the ventricles contract, the apex of the heart is pushed against the chest wall, where it can be distinctly felt below the left nipple.

THE BLOODVESSELS.

The Arteries are vessels which convey blood *from* the heart to the various tissues of the body. Arteries, unless they are very small, possess walls containing three coats: (1) An outer coat of fibrous tissue. (2) A middle muscular coat. (3) An inner elastic coat, which is lined with endothelium, similar to the endocardium lining the heart. The aorta is the main artery of the body, and receives the blood, as we have seen, from the left ventricle. It is about the thickness of the thumb, and commences behind the breastbone, passing as the arch of the aorta to the left side. This part of the aorta gives off large branches to the head and neck and upper limbs. The vessel now passes down the thorax as the *Thoracic* or *Descending Aorta*, lying on the left side of the spine. It gives off branches which run

along each rib (intercostal arteries), and branches to the lungs and œsophagus. The vessel passes through an opening between the diaphragm and the vertebral column to the abdomen, when it is called the *Abdominal Aorta.* In the abdomen it gives off large branches to the stomach and intestines, liver, pancreas, spleen, etc., and at the lower part of the abdomen it divides into two large vessels, the *Right and Left Common Iliac Arteries.* These arteries in their turn divide, one branch being continued down the leg as the femoral artery, and the other supplies the organs in the pelvis with blood. The *Femoral Artery* passes down the inner aspect of the thigh to the back of the knee-joint, when it is called the *Popliteal Artery,* which divides just below the knee into the *Anterior Tibial Artery* for the front of the leg and dorsum, or back of the foot, and the *Posterior Tibial Artery,* which supplies the back of the leg and the sole of the foot.

Arteries of the Head and Upper Limbs.—We have said that the arch of the aorta gives off large branches to the head, neck, and upper limbs. The first vessel, the *Innominate Artery,* divides into the *Right Common Carotid Artery,* which passes up the right side of the neck to supply the head, and the *Right Subclavian Artery,* which passes beneath the collar-bone to the right arm. This artery is called the *Axillary Artery* in the armpit; then it passes down the arm as the *Brachial Artery,* which divides just below the elbow into the *Radial Artery* and the *Ulnar Artery* for the outer and inner aspects of the arm respectively and for the hand.

Arteries of the Head.—The *Common Carotid Artery* passes up the side of the neck and divides at the level of the larynx (Adam's apple) into two trunks—(1) The *Internal Carotid Artery,* which supplies the brain; and (2) the *External Carotid Artery,* which supplies the face and head. Its chief branches are the *Occipital Artery* (to the back of the head), the *Lingual Artery* (to the tongue), the *Facial Artery* (to the face and scalp). The vessel is continued upwards as the *Temporal Artery* to the top of the scalp.

From the arch of the aorta the *Left Common Carotid Artery* and the *Left Subclavian Artery* supply the left side of the head and the left arm in the same manner as the arteries of the right side.

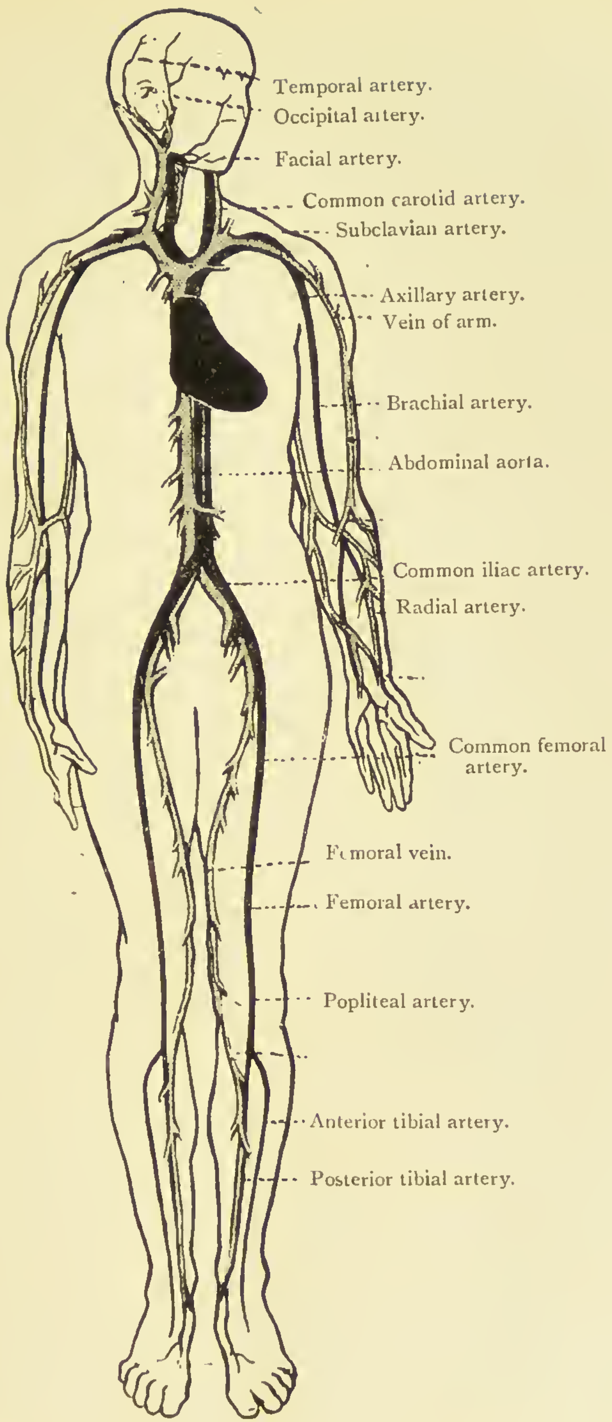


DIAGRAM SHOWING THE COURSE OF THE CHIEF ARTERIES.

The Pulse.—It has been said that the walls of the arteries are elastic and muscular. They are thus able to distend and contract, and drive the blood onwards in a way that would be impossible if the arteries were rigid tubes. With each beat of the heart a wave passes along the aorta, its elastic walls expand, and the wave of expansion is transmitted along the arteries, causing what is known as the *pulse,* which can be felt whenever a vessel of any size comes near the surface of the body—for instance, at the wrist (the Radial Artery), or at the front of the ankle, where the leg joins the foot (Anterior Tibial Artery), or at the temple (Temporal Artery).

The pulse occurs an appreciable time after the heart-beat, because it takes some time (about an eighteenth of a second) for the pulse-wave to travel from the heart to the wrist, for instance. The pulse travels 30 feet per second, the *blood-current* in the aorta is 1 foot per second. In twenty-five heart-beats there is a complete circuit of blood. The heart and pulse beats occur about seventy-five or eighty times a minute, but the rate varies if a person is lying down, standing or walking, calm or excited. Exercise and emotion increase the rapidity of the heart-beat, and in children the pulse is more rapid. In a newborn baby it may be 130 or 140 times per minute.

The Capillaries.—The main arteries branch and subdivide as they pass to the different parts of the body, when the bloodvessels get so small as to be unable to divide further; they are called *capillaries* because they are as fine as hairs. A capillary is really a tube composed of one layer of endothelial cells lying edge to edge. Material from the blood can ooze through these thin walls and give up oxygen and nourishment to the tissues. The blood then becomes venous, and the arterial capillaries anastomose or mingle with other capillaries, called "venous capillaries," which gradually unite together and increase in size to form small veins. These veins join other veins, which pass up the body, carrying venous blood to the heart.

The Veins.—The veins have also three coats, which are much thinner than the coats of the arteries, because they have not to force the blood so far as have the arteries. The veins also are supplied with valves at regular intervals,

which prevent the blood flowing backwards. The valves are folds of endothelium, the lining membrane of the vessels.

Deep Veins accompany the artery, and are called by the same name as the artery—for example, the Femoral Vein. *Superficial Veins* can be seen as blue streaks under the skin, and they do not accompany arteries. All veins are ultimately collected into the Superior or the Inferior Vena Cava, which open into the right auricle.

THE CIRCULATION OF BLOOD.

There are three varieties of blood-circulation in the body—

1. **The General Circulation** comprises all the bloodvessels of the body, except those peculiar to the lungs and the liver. The left side of the heart propels the arterial blood through the body by means of the arteries, capillaries, and veins.

2. **The Pulmonary Circulation** or **Lung Circulation** comprises the blood sent by the right ventricle through the pulmonary arteries to the lungs, to be aerated and returned by the Pulmonary Veins to the left auricle. Note that the *Pulmonary Artery* contains *venous* blood, and the pulmonary veins *arterial* blood. An artery is defined as a vessel which takes blood *from* the heart, whether it contains venous or arterial blood.

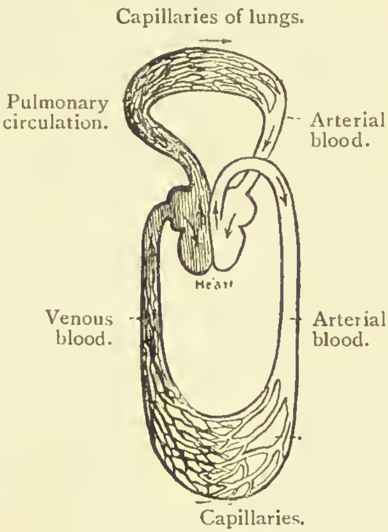


DIAGRAM SHOWING CIRCULATION OF THE BLOOD.

3. **The Portal Circulation** or **Liver Circulation** is composed of the portal vein, which conveys blood from the stomach, intestines, spleen, and pancreas, to the liver. This blood, of course, contains a large amount of nourishment, some of which is stored in the liver. The vessel breaks up into branches, which end in capillaries in the liver substance. From these capillaries the blood is collected again into a large vein, the Hepatic Vein, which opens into the Inferior Vena Cava.

CHAPTER VI

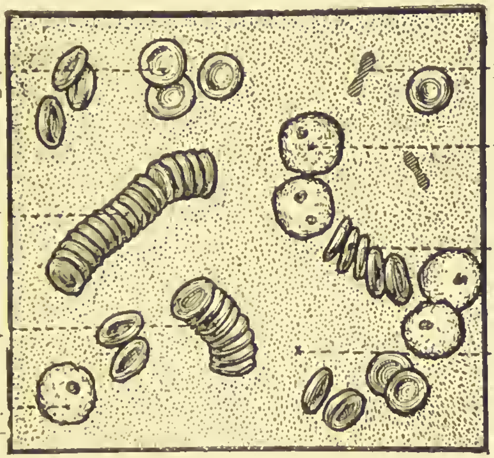
THE BLOOD AND LYMPH

Constituents of the blood — Clotting — The lymphatic system — Lymph—The ductless glands—The spleen—Suprarenal capsules —Pituitary body—Thymus gland—Thyroid gland.

The Blood.—To the naked eye the blood appears to be a red fluid. If it is examined microscopically it is seen to consist of a clear fluid, the *plasma,* and of solid bodies floating in it called the *corpuscles.* These are of two kinds—red and white corpuscles.

The Red Corpuscles are circular, non-nucleated bi-concave discs—that is, each corpuscle is like a minute coin, thinner in the centre than at the edge. A red corpuscle measures about $\frac{1}{3200}$ inch. It is composed of a spongy network, containing in its meshes a red colouring matter called *hæmoglobin.* Hæmoglobin is a protein substance which has the power of uniting with oxygen. When blood circulates through the lungs the hæmoglobin in the red corpuscles absorbs the oxygen from the inspired air, and afterwards gives it up to the tissues through which the blood circulates. Under the microscope the red corpuscles are seen to run together in rows, like a pile of coins (rouleaux). A small drop of blood will contain over five million red corpuscles. In the disease called "anæmia," or "bloodlessness," which is very common amongst girls, the red corpuscles are deficient in quality and quantity. There is consequently an insufficient amount of hæmoglobin, and so the body is deprived of its normal amount of oxygen, and such symptoms as breathlessness, languor, and fatigue develop. The pallor of anæmic girls is due to the deficiency of red colouring matter in the blood. The condition will be more fully described under the section on personal hygiene.

The White Corpuscles are slightly larger than the red, and are much less numerous. A small drop of blood will only contain about six thousand of them, but the number varies even in health. Each white corpuscle is a cell composed of protoplasm, containing a nucleus and various dark granules or dots. The white corpuscles have the power of moving and changing their shape. The red corpuscles, on the other hand, have no power of movement in themselves, and they are non-nucleated. There are different types of white corpuscles in the blood, and they have probably various functions. One variety of white corpuscle, for instance, has the power of passing through the



THE BLOOD (MAGNIFIED).

bloodvessel walls, and attacking disease germs in the tissues. "Inflammation" follows, and a certain number of the corpuscles die, with the result that sometimes an abscess is formed full of dead cells and dead germs—*i.e.*, pus. The blood is continually requiring a new supply of corpuscles, both red and white. The red corpuscles are provided by the marrow cells in the bones. Certain cells in the marrow have the power of active propagation or multiplication by division, and these are the parent cells of the red corpuscles. White corpuscles are also formed in the marrow, and in the lymphatic tissues, as we shall see.

Clotting of the Blood.—When blood escapes from the body and comes in contact with a foreign substance, it clots

or sets like jelly. If left for some time, drops of a light yellow liquid will appear on the top of the clot, which is seen to shrink or contract; and the blood ultimately separates into a solid red clot and a clear liquid, called serum. The solid part consists of fibrin (a network of fine threads, which is derived from a soluble substance in the blood, called "fibrinogen"), and red and white corpuscles entangled in it. It is through this characteristic clotting or coagulation of the blood that bleeding or hæmorrhage is arrested. If the finger is cut, the blood which escapes clots, forming a crust over the surface, under which the wound will heal.

THE LYMPHATIC SYSTEM.

It has been mentioned that certain white corpuscles are obtained from the lymphatic system. The lymphatic system consists of a series of minute, thin-walled vessels (lymphatics), which contain a clear fluid, called *lymph.* This lymph is largely derived from the blood which passes through the walls of the capillaries to bathe them with oxygen and nourishment. The surplus, which is lymph, contains the waste products from the tissues, and it is carried back to the blood-stream by the lymphatic vessels, the lymph being the intermediary between the blood and the tissues. The lymphatic system may be regarded as the drainage system of the body. Lymph is carried away by the lymphatic vessels, which in their course through the body pass at intervals through little rounded structures (which vary in size from a pea to a small bean), called *lymphatic glands.* These are made up of a fibrous meshwork, containing numerous cells, like the white corpuscles, which pass into the lymph as it flows through the glands. The lymphatic vessels ultimately open into veins at the root of the neck, and so the lymph is poured directly into the blood. Groups of lymphatic glands are found in the neck, the armpit, the groin, below the jaw, in the abdomen, and in the thorax. These lymph glands have the power of filtering poisons, and preventing them from entering the blood. For example, a poisoned cut in the finger will cause swelling in the glands of the armpit; a sore throat or decayed tooth will cause the neck glands to enlarge, which may lead to the formation of an abscess

Ductless Glands.—There are certain glands in the body whose function is not yet finally determined. These are organs which resemble ordinary glands, but they have no duct, and so they are sometimes called the ductless glands. The chief of these are, in addition to the lymphatic glands, the spleen, the thyroid gland, and the suprarenal capsules.

The Spleen is a dark-coloured pulpy organ, about 5 inches long by 3 inches deep, situated to the left of the stomach and pancreas. It is covered with peritoneum, and has in addition a capsule. In structure it consists of a network of connective tissue, which contains masses of cells, like the white corpuscles of the blood, red blood-corpuscles, and a number of large branched cells. All the functions of the spleen are not yet known. It is concerned with the formation of white corpuscles, which are formed by division of the spleen cells. It is supposed also that worn-out red corpuscles are destroyed or broken up in the spleen pulp. The hæmoglobin derived from this process is carried to the liver by the splenic vein, and there utilised for the manufacture of certain colouring matter in the bile.

The Suprarenal Capsules are situated one on the upper edge of each kidney. Their function is not yet determined. They seem to secrete some material which is necessary to health and life, in common with the other ductless glands already mentioned, and with the *Pituitary Body*, situated at the base of the brain, and the *Thymus Gland*, in the upper part of the thorax.

The Thyroid Gland lies in front of the neck in the region of Adam's apple. This body also has to do with internal secretion. It produces some material essential to health. A child born with the thyroid defective or lacking does not develop normally; he becomes a cretin, or idiot dwarf. Extract of thyroid is given in these cases, with good results. In the same way, when the thyroid glands are removed, the patient becomes lethargic mentally and physically. Goitre, a disease common in Switzerland, is an enlargement of the thyroid gland.

CHAPTER VII

RESPIRATION AND THE VOICE

Composition of air—Organs of respiration—The lungs, etc.—Mechanism of respiration—Other respiratory movements—The voice.

We have learned that oxygen is essential to the vitality of the blood, to the life of the tissues, and the nutrition or health of the body. Oxygen is derived from the air by the process of respiration.

Composition of Air.—Air is a mixture of oxygen and nitrogen, with a trace of carbonic acid, and a varying amount of moisture or water vapour, ozone, ammonia, and organic impurities. When fresh air is breathed into the lungs it gives up oxygen, and receives a certain amount of carbonic acid gas and a large amount of moisture. The proportion of nitrogen is unaltered. The following table indicates the proportions of the various constituents in 100 volumes of air:

	Inspired Air.	Expired Air.
Oxygen	20·96	16·96
Nitrogen	79·00	79·00
Carbonic acid ..	0·04	4·04
	100·00*	100·00†

Nitrogen is a colourless, tasteless, odourless gas. Its function is to dilute or modify the oxygen in the air.

Oxygen is the most important constituent of air. It is a colourless, tasteless, odourless gas, which supports combustion. It is essential to life, and an animal kept in a closed chamber will die after the oxygen has been used up.

* Water vapour variable; suspended particles.
† Water vapour saturated; organic matter.

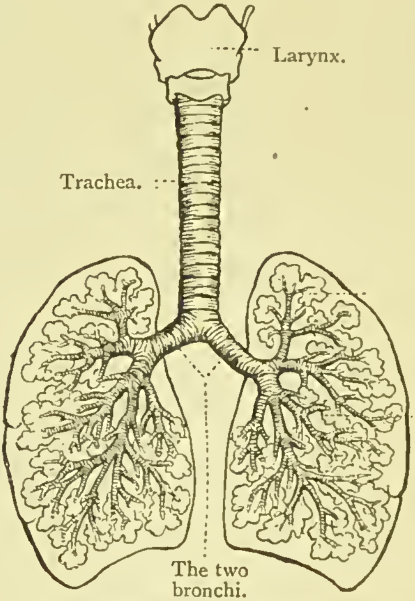
Carbon Dioxide (carbonic acid gas) is present in fresh air to the extent of 0·04 per cent., or four volumes in every 10,000 volumes of air. It is a colourless gas, with a slight taste and smell. Its presence can be detected by its action on lime-water (see p. 54). Carbon dioxide will not support combustion or respiration. Large quantities of this gas are being poured into the atmosphere continually, from the respiration of animals, and from the combustion of wood, gas, candles, lamps, etc. (In combustion carbon unites with oxygen to produce carbonic acid gas.) The amount of carbon dioxide in the atmosphere remains fairly constant, owing to the action of plants, which have the power of absorbing carbonic acid gas from the air, retaining the carbon for their own needs, and giving up oxygen to the air. Whilst fresh air only contains 0·04 per cent. of this gas, in towns the amount may be rather more, and in ill-ventilated rooms considerable impurity may exist. The maximum permissible percentage of carbon dioxide that may be allowed is 0·06 per cent. or 6 parts per 10,000; anything above this amount will cause headache, drowsiness, and depression.

Water Vapour is constantly present in air, being derived from the earth's surface and from respiration and combustion. Warm air can "hold" more water vapour than cool air. When air at any given temperature cannot take up more water vapour, it is said to be saturated; and if the temperature of saturated air is lowered, the excess of vapour is deposited as moisture. Minute quantities of *ammonia* are contained in the atmosphere, and various *suspended impurities—i.e.*, dust, wood particles, seeds, scales of skin and hair, disease germs, and many "innocent" germs or harmless organisms. The presence of suspended impurities is visibly demonstrated when a ray of sunshine enters a dark room. Gaseous impurities include carbon dioxide, various sulphur compounds, sewer gas, carbon monoxide or carbonic oxide (produced by imperfect combustion), coal gas, etc.

ORGANS OF RESPIRATION.

Air is inspired through the respiratory passages—the nose, the pharynx, the larynx, the trachea, and the bronchial tubes—into the lungs. The nasal passages are

separated by a medium septum, and lined with mucous membrane, which is richly supplied with bloodvessels; and the inspired air is warmed and filtered by the moist surface of the membrane and the hairs near the nasal openings. The nasal cavity is separated from the mouth by the palate, and it is roofed by the ethmoid bone, which is perforated by the nerves of smell. On either side of the nasal passages are the turbinate bones. These passages open behind into the pharynx, a wide cavity at the back of the nose and mouth, which has opening from it two

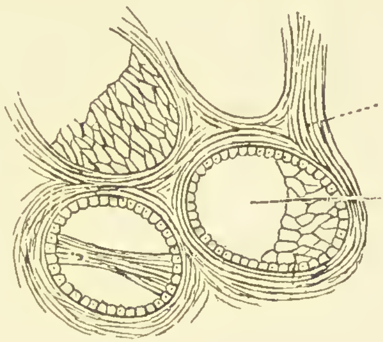


Organs of Respiration.

tubes—the œsophagus behind, which conveys food from the pharynx to the stomach; and the larynx in front, which is continued below as the trachea, a tube about $4\frac{1}{2}$ inches long, which is kept open by C-shaped rings of cartilage in its walls. It is lined by mucous membrane, the surface cells of which are ciliated—that is, they have hair-like processes, the movements of which prevent dust particles being carried down the trachea. In the chest the trachea divides into two bronchi, one to each lung. The walls of the bronchi, like the trachea, consist of muscle,

cartilage, and fibrous tissue. Each bronchus divides and subdivides through the lung tissue, until the branches become so small that they cannot divide farther, and so the tiny bronchi expand into *air sacs*, or dilated cavities. A dilated cavity is called an *infundibulum*, which shows a number of tiny chambers opening into it, each chamber being called an alveolus.

Structure of the Lungs.—Each lung consists of an infinite number of air sacs or dilated ends of bronchioles, held together by connective tissue, the whole being enveloped in the pleural membrane. Each alveolus is lined by a layer of flat cells lying upon a layer of elastic tissue, which contains a network of capillaries, the ultimate branches of the pulmonary artery. From these capillaries the pulmonary veins are formed to convey the aerated blood back to the heart.



MICROSCOPIC STRUCTURE OF LUNGS.

Between the air in the alveolus and the blood in the capillaries we have simply a very thin, delicate partition, which allows oxygen to pass from the air in the alveolus right into the blood, there to combine with the hæmoglobin in the red corpuscles. At the same time carbonic acid gas passes from the blood through the capillary wall and the alveolus wall, and passes up the bronchial tubes in expiration. If the lungs of a sheep are examined, they are seen to be mottled, spongy organs, which can easily be expanded by blowing air with bellows down the trachea. When the bellows are removed, the lungs collapse, owing to the elastic tissue in their substance. The lungs will float if placed in water, owing to the amount of air they contain in their air cells.

MECHANISM OF RESPIRATION.

Respiration consists of two acts, with a slight pause between—namely, *inspiration*, when air is drawn into the lungs, and *expiration*, when air is expelled from the lungs.

Respiration is brought about by the alternate expansion and contraction of the chest. In inspiration the size of the chest is increased—(1) by raising the ribs, through the contraction of the intercostal and various other muscles, which pushes the sternum forwards; this increases the cavity from before backwards, and at the same time increases the capacity of the chest from side to side. (2) By causing the muscular diaphragm to descend upon the abdominal organs. When the diaphragm descends, the abdominal wall comes forward. Breathing is said to be *thoracic* when it is chiefly brought about by the action of the ribs, and *abdominal* when the movement of the diaphragm is marked. Men and children show abdominal breathing, whilst in women respiratory movement is most marked in the upper part of the chest; but this is almost entirely due to the greater restriction of women's clothing in the waist and abdominal regions. When the chest enlarges, air rushes in through the respiratory passages and distends the lungs. At the close of inspiration there is a short pause; then, owing to the elasticity of the ribs and their cartilages and of the lung tissues, air is forced from the lungs in expiration.

Rate of Breathing.—In quiet breathing the double act of inspiration and expiration occurs about sixteen to twenty times per minute.

Breathing is modified by posture and by emotion. Exercise quickens the rate, and age affects it. A child of one year will breathe as quickly as forty times per minute, and a child of six years will breathe twenty-two or twenty-four times per minute. The rate of breathing is affected by the amount of carbonic acid in the blood; the proportion of this gas increases in exercise, and the excess of carbonic acid in the blood stimulates the *respiratory centre* in the brain, the nervous centre which controls respiration. Anything preventing the entry of air to the lungs—*i.e.*, pressure on the neck or on the chest—produces the condition known as asphyxia. The blood cannot be aerated, and therefore gets more and more venous, and unless the obstruction is removed, the body becomes asphyxiated, and the heart beats more and more feebly until death results.

Amount of Air.—The air which passes in and out of the lungs measures about 25 to 30 cubic inches. This

is termed *tidal air*, and it mixes with 200 cubic inches of air in the lungs. When a long breath is taken, an extra allowance of air (about 100 cubic inches) is inspired, and this is called *complemental air*. By a forced expiration one can breathe out 100 cubic inches of air more than the tidal amount, and this is called *reserve*. The lungs can never be wholly emptied. There always remains about 100 cubic inches of *residual* air after the strongest expiration. The size of the chest is of less importance than the chest expansion power, which can be estimated by means of a tape measure round the chest. A long, deep breath is taken, and the difference between the chest before and after this inspiration is noted. An average healthy man should have a chest expansion of at least 3 inches. Breathing exercises will increase the chest expansion power.

Other Respiratory Movements.—In *coughing*, a strong expiration follows inspiration in an effort to expel irritating material from the respiratory organs. The glottis is forced open with each expiration. *Sneezing* is a sudden, strong expiration, forcing air through the nose. *Yawning* is a long, deep inspiration with the mouth open. In *hiccough* there is a spasmodic contraction of the diaphragm and of the glottis.

The Amount of Carbonic Acid expired.—We have said that the blood in the lung capillaries gives up carbonic acid gas and takes up oxygen. A man expires about 0·6 feet of carbon dioxide per hour, or 14·5 cubic feet every twenty-four hours. During active work or exercise the amount is increased to over 1 cubic foot per hour. The carbonic acid gas escapes from the blood in the lung capillaries to the air cells by the law of diffusion of gases, which means that when two gases are separated by a moist membrane (in this case the capillary walls), they will gradually pass through the membrane and mix, the lighter gas passing through the more rapidly. The carbonic acid in the air cells gradually diffuses its way upwards through the air passages as the oxygen in the air diffuses downwards to the air cells.

THE VOICE.

The voice is produced in an organ called the larynx. In speech, the lips, tongue, and palate are involved in the proper articulation or enunciation of sound. "The speech centre" is that part of the brain controlling speech.

The Larynx is a funnel-shaped structure, with its narrow end continuous with the trachea below. It is made up of various cartilages, connected by a membrane, the movement of the cartilages being controlled by muscles.

The Thyroid Cartilage consists of two wings, which meet in front and produce the swelling known as Adam's apple.

The Cricoid Cartilage is a smaller cartilage, shaped like a signet ring, with the seal part of the ring at the back, and it lies below the thyroid cartilage.

The Arytenoid Cartilages are two small cartilages lying at the back of the cricoid cartilage.

The Vocal Cords are strong folds of mucous membrane, passing from the angle of the thyroid cartilage in front to the arytenoid cartilages behind. Between the two vocal cords there is an opening called the *glottis*, which can be opened or closed by the action of the arytenoid cartilages. The *epiglottis* is a thin valve of cartilage, shaped rather like an egg-spoon. It is attached to the thyroid cartilage, and in swallowing the larynx is pulled up and the epiglottis is folded down over the entrance to the larynx. When the vocal cords vibrate, the voice is produced. The loudness depends upon the force of the blast and the pitch upon the length and tenseness of the cords. People whose voices are deep have long vocal cords. The vocal cords of a woman are shorter than those of a man, and so the voice is a higher pitch. The pitch is also affected by the tension of the cords, which is influenced by the movements of the cartilages. When sound is produced in the larynx, it is modified by the shape of the mouth. For example, the different vowel sounds depend upon the shape of the mouth in expiration. The consonants are produced by various interruptions of the breath as it escapes, and certain consonants, such as *P*, *T*, *B*, *D*, are not accompanied by vibration of the vocal cords. Clear enunciation is dependent upon the harmony or co-ordination of the muscles concerned in articulation.

CHAPTER VIII

VENTILATION

Necessity for ventilation—Amount of air necessary for human beings—Tests for impurities—Agents for purifying air—Temperature—Moisture—Methods of ventilation—Inlets and outlets—Artificial ventilation.

VENTILATION is the method by which air containing the products of respiration and combustion is replaced by fresh air. The chief injurious products in air are carbon dioxide and various organic impurities. As a rule the purity or impurity of an atmosphere is stated in the amount of carbonic acid gas present. There is a fairly constant ratio between the amount of organic impurity and the amount of carbon dioxide. It is the organic matter in the atmosphere which makes an ill-ventilated room smell "close," and it is such substances, rather than the carbonic acid gas, which are dangerous to health. External air contains in 10,000 volumes, 4 volumes of carbon dioxide. If we have 6 parts of carbonic acid gas to 10,000 parts of air, the atmosphere of a room is said to be "close," and this is the limit of impurity which can be considered compatible with health. An adult, as we have said, expires 0·6 cubic foot of carbon dioxide per hour, and the limit of permissible added carbonic acid gas is 2 parts per 10,000 of air (or 1 in 5,000), which, with the 4 parts already in the air, makes the total impurities 6 parts per 10,000. So that a person must be supplied with 0·6 of 5,000 cubic feet of fresh air per hour—*i.e.*, 3,000 cubic feet per hour. The air in a room can be changed three times per hour without draught, and so we may take it that 1,000 cubic feet of space should be regarded as the minimum space for one person. A sick person should be allowed a larger supply of fresh air—at

least 4,000 cubic feet per hour. It must be borne in mind that space is not everything: a small, well-ventilated room is more hygienic than a spacious room where the air is not kept constantly changed by efficient ventilation. A high room is not necessarily an advantage—anything over 14 feet is, in a sense, waste space. The minimum amount of space for each person in institutions, etc., should be 500 cubic feet; in hospitals the allowance is 1,500 cubic feet.

The Test for Impurities can be very simply done if a glass beaker or tumbler is taken into a room and allowed to stand for a little time. Some clear lime-water is placed in the beaker (to a glass of about 10 fluid ounce capacity, a teaspoonful of lime-water should be added), and the lime-water and air are shaken together. The fluid will remain clear if the air is fresh, and it will turn milky if the atmosphere is vitiated.

Agents for Purifying the Air.—(1) Wind cleanses the atmosphere of impurities by carrying them away. (2) Rain also washes the air of suspended and gaseous impurities. (3) The law of diffusion of gases. (4) Oxygen has the power of oxidising organic impurities. (5) The action of plants on carbon dioxide.

Temperature and Moisture of Air.—The temperature of the atmosphere varies according to climate and season. The temperature of rooms should be maintained at about 60° F., but nurseries and school-rooms require to be kept at a temperature of 65° F., because children are more susceptible to cold. The degree of dampness or humidity of the atmosphere affects the general health. If the air is saturated with moisture, bodily evaporation is checked, and the water vapour brought up from the lungs tends to be deposited upon any cold surface in the room, such as the window. Air that is too dry is also objectionable, because of its effect upon the skin and on breathing. It has been estimated that the degree of humidity most favourable to health is about 70 per cent.

METHODS OF VENTILATION

In ventilating houses, it is essential in the first place to arrange an inlet for fresh air and an outlet for the escape of foul air. In order to provide 3,000 cubic feet of fresh

air per hour, an inlet measuring 24 square inches and an outlet of the same size should be provided for each person. This will allow the air to enter the room at the rate of 5 feet per second, which means that there should be no draught. As foul air is warmer than fresh air, it tends to rise, and so the outlet should be close to the ceiling. The inlet can be placed at the floor level, if some arrangement is made to warm the entering air; but if this cannot be done, it is best to arrange that the air enters the room at about 6 feet from the floor, and passes in an upward direction. The chief inlets may be considered under the headings of doors and windows, openings through the wall, openings at the floor fitted with vertical tubes or shafts.

Window Ventilation.—The open window is obviously the simplest method of allowing fresh air to enter the ordinary living-room. The window can be opened from the top, and there should be no apparent draught, unless there is a marked difference between the external temperature and the temperature in the room. Draught, however, can very simply be avoided by adopting the suggestion of *Dr. Hinckes-Bird.* The lower sash is raised 3 or 4 inches; in the space thus made an accurately fitting wooden board is inserted. The air enters between the sashes, and passes in an upward direction towards the roof. Windows are now being constructed in many houses so that the upper part is made to work on a hinge, so that the top can be pulled inwards and downwards. If a piece of glass or wood is placed at either side of the pane, there can be no down draught.

The Louvre Ventilator is an arrangement on the principle of a Venetian blind, the ordinary pane of glass being removed, and the space fitted with strips of glass slanting upwards and inwards, which allow air to enter between them, the spaces being increased or diminished by means of cords.

Cooper's Ventilator consists of a pane of glass containing holes arranged in a circle. It can be opened or closed by a revolving disc of glass, worked on a pivot (hit and miss ventilator).

Double Panes are also used. The inner pane has a space above, the outer pane has a space at the bottom, and the

fresh air enters between the two. As these are generally fixed sashes, they cannot very well be kept clean.

Double Windows ensure good ventilation, because the lower sash of the outer window can be raised, and the upper sash of the inner window lowered. The fresh air enters between the two windows, and is directed upwards.

Other Inlets for Fresh Air—*Tobin's Tubes.*—The air enters through an opening in the wall at the floor level, which is protected outside by a grating or ventilating brick. It is then directed 5 or 6 feet upwards in a tube or verticle shaft, the top of which is fitted with a valve to regulate the amount of entering air.

Sheringham's Valve consists of an iron box, fitted on the inside with a hopper valve, and a grating outside. The box is placed in a hole in the wall, about 8 feet from the floor. The air passes from the outside through the grating and into the room, the amount of air being regulated by opening or closing the valve, which is worked by a pulley.

Ellison's Bricks are bricks pierced with conical holes, the apex of the cone being directed towards the outer air, so that the velocity of the air is decreased as it enters, and draught is prevented.

Outlet Ventilators.—The chief outlet is the chimney, which will allow 4,000 to 12,000 or 15,000 cubic feet of air to escape per hour when a fire is burning. When, however, there is no fire, some other form of outlet ventilation is necessary, if there are several people in the room, and especially if gases or lamps are being burnt. The chief methods are—

Arnott's Valve, an iron box with a valve arranged so as to allow the air to escape into the chimney, and to prevent the backward passage of smoke. It is fixed in an opening in the wall near the ceiling. These valves are apt to get out of order, and they are often objected to on account of the clicking noise they make.

Boyle's Mica Flap is a ventilator similar to Arnott's, having four small valves made of mica.

Shaft Ventilator.—An efficient outlet can be provided by having a separate air-shaft in the same stack with the flue, which is allowed to communicate through an opening with

each room near the ceiling. The warm air ascends towards the roof and passes into the shaft.

M'Kinnell's Ventilator is suitable for fixing like a chimney into the roof of rooms which are at the top of a building or for bungalows of one story. It consists of two concentric tubes, the inner tube forming an outlet, and the space between the tubes an inlet. The tubes are protected by a hood to prevent the entry of rain.

For roof ventilation *Boyle's Air Pump Ventilator* allows the wind to blow through, and reduces pressure so that the air passes out.

Artificial Ventilation.—For larger buildings, such as hospitals, prisons, schools, etc., to be efficiently ventilated, the air has to be kept in motion by machinery. The simplest method is by *extraction*, or aspiration of the foul air, such as is generally used in theatres, where the gas-jets are placed under outlet tubes, and the warm vitiated air expands and passes up the tubes which unite to form one large outlet. The disadvantage of the extraction system is that the air which rushes in to take the place of the extracted air may be obtained from undesirable sources. Another method is by *propulsion*, in which the fresh air is driven along conduits, the vitiated air escaping by shafts or flues. The air is kept in motion by fans or screws, driven by engines. Ventilation by propulsion can be better controlled than the extraction system, which, however, is cheaper. The best plan is to combine the two methods. In the House of Commons fresh air enters the basement, where it is washed or filtered through moistened screens, then warmed over steam-pipes, and passed by shafts to spaces beneath the floor. The foul air passes through openings in the ceilings, to be conducted by a shaft to the basement of the clock-tower. The furnace flue directs the air upwards by a powerful exhaust.

CHAPTER IX

THE BRAIN AND CRANIAL NERVES

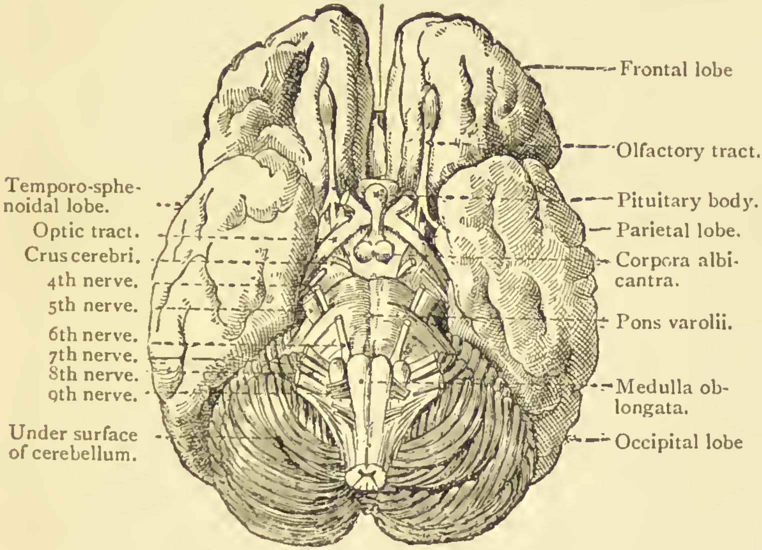
Function of the nervous system—The brain and its membranes—Medulla—Pons—Cerebellum—The cerebrum—The cranial nerves.

FROM the previous chapters on elementary physiology it is apparent that the human body consists of various organs arranged in systems concerned with some special function, as, for example, the digestive system, which consists of the organs for the conversion of food into nourishment for the body. We have also studied the heart, which is the organ for the propulsion of blood through the body, and the lungs, which have to do with the oxygenation of blood. We have now to consider the construction and working of the nervous system. Just as an engine requires a guiding hand or intelligent force behind it, so also it is necessary that there should be some regulating power in the body to ensure that the various parts or organs do their special work. This is supplied in the form of the delicate apparatus called the nervous system, which regulates every organ, every tissue—in a sense, every cell of the body. Because we are supplied with a nervous system, we are sensitive, active, reasoning beings. Because our brain is a highly developed organ, we possess, or we ought to possess, reasons, intelligence, will, and understanding. For the sake of description we shall divide the nervous system into four parts—(1) The Brain; (2) The Spinal Cord; (3) The Nerves; (4) The Sympathetic System—and we shall consider them in turn.

THE BRAIN.

The brain is a complicated mass of nervous matter contained in the skull, which is a bony box less than ¼ inch thick. The brain is made up of nerve cells and

nerve fibres. The nerve cells are very complex in structure, and lie over the surface of the brain, forming what is called the grey matter. In this grey matter all ideas are formed, "will" is originated, and sensations are perceived. It is the organ of consciousness—in a word, the *mind*. The nerve fibres of the brain pass from the nerve cells downwards to the spinal cord, outwards from the spinal cord as spinal nerves, and so to all parts of the body. If the skull were opened, the living brain would be found to be enclosed in three protective membranes, between which lies a quantity of fluid which provides a sort of water-bed



BASE OF THE BRAIN.

to protect the semi-solid organ. Next to the brain is the *pia mater*, a thin membrane. Externally is the *dura mater*, a fibrous membrane lining the skull. Between these two is the *arachnoid*. The space between the membranes is filled with a watery fluid called cerebro-spinal fluid, which is also found in the space between the membranes of the spinal cord. The surface of the brain is raised into a series of folds called "convolutions." These convolutions increase the surface area of the brain, and the different convolutions have different functions. For example, if we could stimulate a convolution situated

about the middle of one side of the brain, we should produce movements of the leg or arm of the opposite side of the body, because the muscles of these limbs, and, indeed, of the whole left side of the body, are controlled by that particular area of the brain. The brain consists of the cerebrum, cerebellum, pons, and medulla.

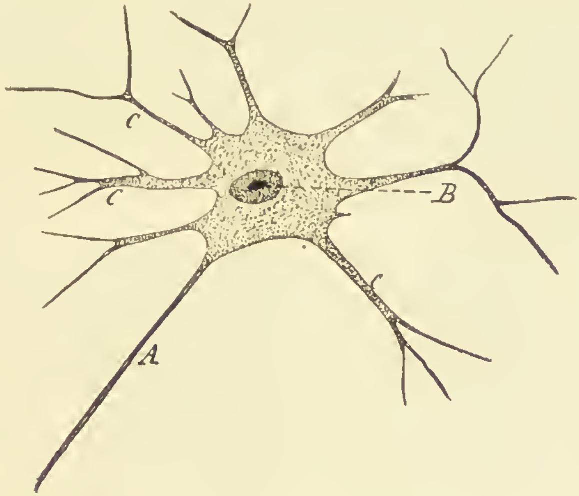
The Medulla is continuous with the upper part of the spinal cord. It is thus the lowest part of the brain, and its functions are similar to those of the spinal cord. The medulla also contains areas of grey matter, certain nervous " centres "—*i.e.*, the respiratory centre controls breathing, the circulatory centre controls the movements of the heart, etc. We shall see later that the medulla is a centre for what is called reflex action. It is also important to remember that the nerve fibres coming down from the brain cross in the medulla to pass down the opposite side of the spinal cord—that is, the nerve fibres from the right side of the brain cross in the medulla to the left side, and proceed downwards on the left side of the spinal cord. Thus it can be seen that an injury to the right side of the brain will be followed by paralysis of the left side of the body.

The Pons lies immediately above the medulla. It is composed of fibres passing from one half of the cerebellum to the other.

The Cerebellum, or little brain, lies in the hinder or posterior part of the skull—the part which corresponds to the occipital bone. It is divided by a deep fissure into a right and left half, each being continuous with the other through the pons, and continuous with the medulla below and with the cerebrum above. The cerebellum has to do with regulating muscular movement or with balancing, but its functions are not yet definitely known.

The Cerebrum, or great brain, consists of two halves or hemispheres, which are separated from one another by a deep cleft. It is impossible in such a book as this to give any idea of the wonderful functions of the different areas of the brain, but it may be said, generally speaking, that the front part or anterior area of the brain has to do with the intellectual functions, the middle (motor) area regulates locomotion and movement, whilst the posterior area at the

back of the head has to do with sensation. Microscopically, the brain is composed of grey and white matter. *The grey matter* (nerve cells) is arranged over the surface of the brain as the cortex, and, again, at the base of the brain it is found as masses of considerable size called the *basal*



NERVE CELL (HIGHLY MAGNIFIED).

A, Axis cylinder or nerve process, containing core or filament of the nerve; *B*, nucleus; *C*, short process.

ganglia. The cortex is concerned with the highest functions of the brain, and microscopically it consists of nerve fibres which have no sheath and nerve cells. These cells are nucleated, they show branching processes (dendrites), and they are connected by one long process with the axis cylinder of a nerve fibre, which with other fibres from other cells forms the white matter of the brain.

The white matter is made up of bundles of white fibres passing downwards to the medulla (where they cross), thence to the spinal cord, to pass off as spinal nerves, which give branches to all parts of the body.

THE CRANIAL NERVES.

From the base of the brain twelve pairs of nerves (cranial nerves) pass through holes in the skull to supply the face and the head. The first pair, for example, are called the

olfactory nerves, and they pass to the nose. The second pair of cranial (optic) nerves have to do with the sense of sight, and therefore pass to the eyes. The third, fourth, and sixth nerves go to the muscles of the eyeballs; the fifth nerve to the head and face. The seventh or facial nerve supplies the muscles of the face, and is thus the nerve of expression. If one facial nerve is cut off from its com munication with the brain, as happens in certain cases of paralysis, it leaves one side of the face wholly or partially paralysed, because the muscles supplied by the facial nerve are no longer controlled by the brain. The following table gives the names and some idea of the function of the cranial nerves:

1st ..	Olfactory	Nerve of smell.
2nd ..	Optic	Nerve of sight.
3rd ..	Motor oculi	Motor to eyeball.
4th ..	Trochlear	Motor to eyeball.
5th ..	Trigeminus	Sensory and motor to muscles of mastication.
6th ..	Abducens	Motor to eyeball.
7th ..	Facial	Motor to muscles of face.
8th ..	Auditory	Nerve of hearing.
9th ..	Glosso-pharyngeal	Motor and sensory to tongue and pharynx.
10th ..	Pneumogastric or vagus	Sensory to mucous membrane of respiratory passages, larynx, etc., heart, and digestive tube; motor to larynx and pharynx, respiratory and digestive tract.
11th ..	Spinal accessory	Motor to glottis, muscles of neck, etc.
12th ..	Hypoglossal	Motor to muscles of tongue, etc.

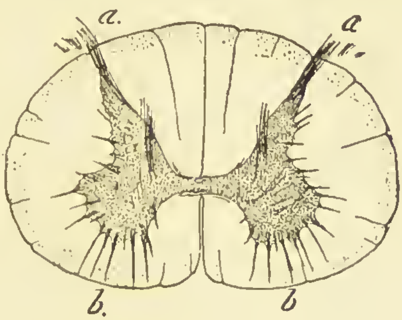
CHAPTER X

THE SPINAL CORD AND NERVES

The membranes—Section of cord—Nerves—Structure of a nerve—The function of nerves—Sensory and motor impulses—Reflex action.

FROM the lower part of the brain a tail-like projection tapers downwards to the upper part of the lumbar region, measuring about 18 inches in length. This is the spinal cord, which lies inside the bony spinal column, just as the brain lies inside the skull. It is about ½ inch in thickness, and it is swollen in two places, at those parts where the nerves for the upper and the lower limbs are given off. It lies in three membranes with cerebro-spinal fluid between—the pia mater, arachnoid, and dura mater.

Section of Spinal Cord.—If the spinal cord is cut across, it is seen to be composed of a central core of grey matter shaped like the letter **H**, surrounded by white matter. Thus it will be seen that while in the brain the grey matter is outside, in the cord the grey matter is inside. The cord is partly divided into two, by an anterior fissure in front and a posterior fissure behind. But the two halves are in communication by a bridge, in the centre of which is a space, which is a fine canal running along the length of the spinal cord. The **H**-like grey matter shows two anterior horns shorter and thicker, and two longer, narrower posterior horns.

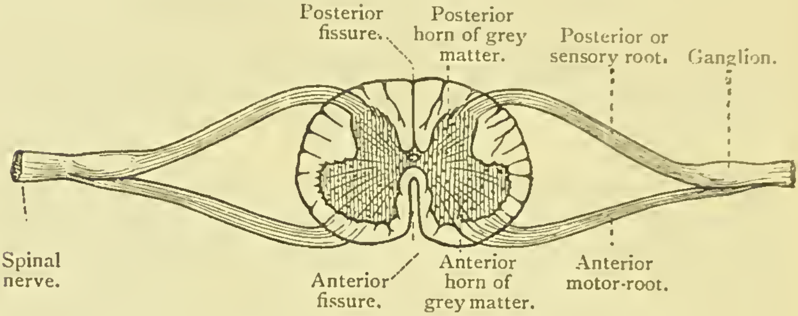


SPINAL SECTION SHOWING RELATIVE POSITIONS OF THE GREY AND WHITE MATTER.

aa, Posterior horns or cornua; *bb*, anterior horns or cornua.

THE NERVES.

The nerves, as has already been mentioned, pass from the brain and spinal cord to all parts of the body. The cranial nerves pass through holes in the skull. The thirty-one pairs of spinal nerves leave the spinal canal through apertures between the vertebræ. These large nerves



divide and subdivide into smaller and smaller branches, which terminate in branches so small as to be invisible to the naked eye.

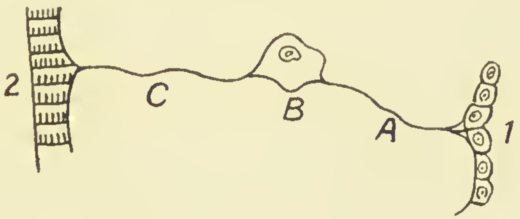
Structure of a Nerve.—Nerves are made up of fibres, arranged in strands or bundles, held together by connective tissue. Under the microscope the structure of the nerve fibre can be seen. It consists of a central core or *axon*, or axis cylinder (which is continuous with a nerve cell in the brain or spinal cord), and a layer of fatty material forming a white sheath, outside of which is a thin sheath of connective tissue.

There are two kinds of nerve fibres: *efferent* or motor fibres, which carry messages *from* the brain or cord to the muscles, or to glands (secretory fibres); and *afferent* or sensory fibres, which carry messages or sensations from all parts of the body *to* the brain or cord. Most nerves contain both efferent and afferent fibres, but in certain nerves—for example, the facial nerve—the fibres are all efferent or motor, and in other nerves—for example, the nerve of smell or of sight—the fibres are all afferent or sensory. A spinal nerve arises by an anterior root, which contains efferent or motor fibres, and a posterior root, which contains afferent or sensory fibres. If the anterior

roots of the nerves supplying the left arm were injured, there would be loss of power in the muscles (motor paralysis) of the limb, but there would be no loss of sensation. If, now, the posterior roots were cut, there would be complete paralysis. We know that nerve impulses pass along the axons of the nerves, the sheath acting merely as a protection to the axon, and to prevent messages passing from one axon to another. These nerve impulses are messages between the central nervous system and the different parts of the body. If, for instance, one placed a finger on a hot range, a message would be sent through the sensory fibres of the nerves of the hand and arm to nerve cells in the cord and brain. These cells would send a message to cells in the motor area, which would transmit along the efferent or motor fibres a message to the muscles of the limb which would contract, and so draw the hand away from the hot surface. Nerve impulses pass so quickly that the perception of pain and the movement of withdrawal appear to be instantaneous.

REFLEX ACTION.

It is not necessary that all such messages should be carried to the *brain*, and, indeed, the jerking away of the hand is an example of reflex action, which would be partly controlled by the spinal cord. Actions which take place



SIMPLE REFLEX ACTION.

1, Sensory surface; 2, muscle; *A*, sensory nerve; *B*, nerve cell; *C*, motor nerve.

without consciousness, or without the intervention of the will, are called reflex actions, and in all reflex actions we find the following mechanism: (1) Stimulation of a sensory or afferent nerve; (2) stimulation of an intermediate nervous or reflex centre; and (3) stimulation of a motor or efferent nerve. The diagram shows a simple reflex action,

but the mechanism is often very complex, as there may be more than one nerve centre, whilst there may be numerous afferent or efferent nerves involved. Reflex centres are made up of grey matter, containing nerve cells, and they are found in the cord and in the brain. Certain movements tend to become automatic or reflex, such as walking, and various forms of manual work, such as knitting. The following are examples of common reflex actions.

m = motor or efferent nerve; s = sensory or afferent nerve; c = reflex centre:

1. Movements of muscles in the limbs or trunk, caused by tickling: s = sensory nerves of skin; c = spinal cord; m = motor nerves to muscles.
2. Sneezing: s = branches of fifth cranial nerve; c = medulla; m = muscles of expiration.
3. Shuddering from grating noises: s = auditory nerve; c = brain and cord; m = motor nerves to muscle.

Inhibition.—Reflex action is more marked during sleep, because what is called the inhibitory or controlling action of the higher nervous system is in abeyance. If the spinal cord is injured, reflex movements below the seat of injury are more active, for the same reason, that the brain is cut off — that is, the restraining influence is diminished. The power of inhibition or control, not only over impulsive movements, but over all our actions and thoughts, can be developed. It is by the action of this function that character evolves, and the individual becomes less a creature of impulse, and more a reasonable, rational, self-controlled human being.

The Sympathetic System consists of a chain of nerves and ganglia (masses of grey matter, cells and their processes) on either side of the spinal cord. These send branches to the vital organs, lungs, heart, stomach, liver, intestines, bladder, etc., to regulate the vital processes of respiration, circulation, digestion, etc.

CHAPTER XI

THE SPECIAL SENSES

Structure of the eye—Sight—Astigmatism—Hypermetropia—Myopia—Prevention of short sight—The Ear and Hearing—Sense of smell—Sense of Taste—Sense of touch.

THE eye is a spherical body about 1 inch in diameter, which lies in the bony orbit. At the back of the orbit there is an opening for the optic nerve and its bloodvessels, the nerve of sight connecting the eye with the brain. The eye has three coats—(1) The sclerotic and cornea; (2) the choroid and iris; (3) the retina. The outermost, the *sclerotic*, is commonly called the "white of the eye." In front it bulges, and is set in the front of the eye like a watch-glass, when it becomes transparent, and is called the *cornea*.

The *choroid* coat consists of a network of bloodvessels with pigmented cells. It is a smooth black membrane lining the *sclerotic*. It is continued into the *iris*. The iris gives the colour to the eye. It is a circular curtain with a hole in the centre—the *pupil*. At the junction of the iris and choroid are a number of processes called the ciliary processes, which are connected with the ciliary muscle, a ring of muscular fibres between the sclerotic and the ciliary processes which, in contracting, draws the choroid forwards. Between the iris and the cornea we have the *anterior chamber*, filled with a colourless fluid, *aqueous humour*. Behind the iris is the *crystalline lens*, transparent and doubly convex, contained in a capsule. It is held in place by the *suspensory ligament*.

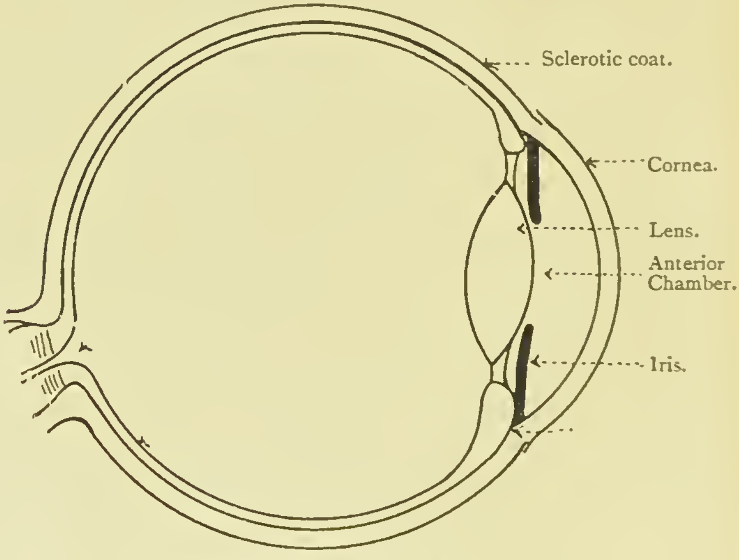
The innermost coat of the eye is the *retina*, which is in a sense formed by the expansion of the optic nerve, after it perforates the sclerotic and choroid. The retina lines

the choroid coat behind the lens. In front of the retina is a jelly-like material, which fills the greater part of the eye, called the *vitreous humour.*

The eye is protected by an upper and lower eyelid, folds of skin lined with mucous membrane, the conjunctiva, which also covers the eyeball. The edges of the lids are fringed with hair, the eyelashes. A series of muscles move the eyeball in various directions. The lachrymal gland, situated at the upper and outer angle, secretes a clear fluid, which cleanses the eye in passing towards the opening of the nasal or tear duct (at the inner angle), which communicates with the nasal cavity.

THE SIGHT.

The eye is frequently compared to an optical instrument. The photographer's camera is modelled upon the eye. It has in front a convex lens, and behind a sheet of ground



THE STRUCTURE OF THE EYE.

glass. Rays of light pass through the camera lens, and are refracted by the lens to form an inverted image of the object upon the sensitive plate of ground glass. In the same way rays of light in the eye are refracted by the

crystalline lens to form images upon the retina. From the retina impressions are passed along the optic nerve to the brain, producing the sensation of sight. The size of the pupil varies with the amount of light. In a bright light the iris closes in or contracts, and the pupil is diminished in size, so that the inner parts of the eye are protected from the glare. In a bad light the pupil dilates. In order to *accommodate* the eye to near or distant vision, the lens has to alter in shape. It becomes more convex in near vision, owing to the action of the ciliary muscles contracting and pulling forward the ciliary processes and choroid. Thus the suspensory ligament is slackened, and pressure is removed from the lens, which bulges forward. In distant vision the ciliary muscles relax, the lens is flattened, so that it refracts less strongly. In normal vision the eye accommodates without effort, and a clear vision of the distant object is formed upon the retina. If, however, the eye is *too long* from before backwards (short sight, or myopia), or *too short* from before backwards (long sight, or hypermetropia), or irregular in its curvature (astigmatism), objects are blurred or indistinct—that is, there is an *error of refraction*.

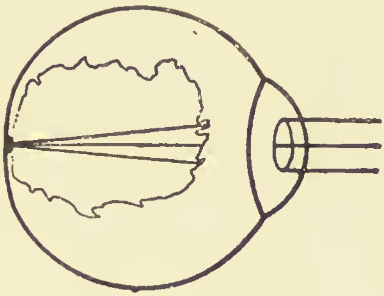


Diagram of Normal Eye.

Astigmatism is that condition of sight when vertical and horizontal lines are not seen with equal clearness at the same time. It is caused by a difference in the degree of the curvature from above downwards and from side to side of the cornea or of the lens. A strong effort is made to focus objects, which causes fatigue of the muscles of accommodation, and such symptoms as headache, depression, etc. Suitable glasses are required to correct the error of refraction.

Hypermetropia, or Long Sight.—In this case the lens is too flat, and the length of the eye from front to back is less than normal. Thus objects are focussed behind the retina. For example, in reading a book, the letters are

indistinct, unless the paper is moved some distance away, and in looking at near objects a strong muscular effort is required to focus the rays upon the retina, which produces fatigue, especially after using the eyes. Double convex glasses are required, which help the lens to refract rays of light more sharply.

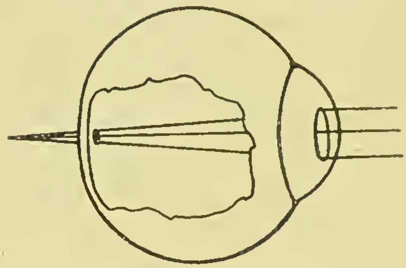


Diagram of Long-Sighted Eye.

Myopia, or Short Sight, is the opposite condition. The lens is more curved than normal, thus it refracts more sharply, and the eyeball is longer from before backwards. Thus rays of light from distant objects are focussed in *front* of the retina, and images are indistinct. Near objects are seen clearly. The condition is remedied by double concave glasses.

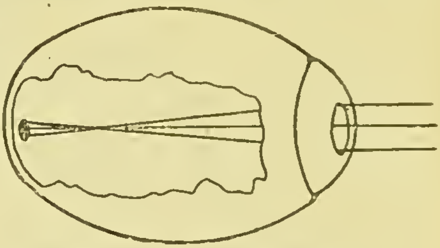


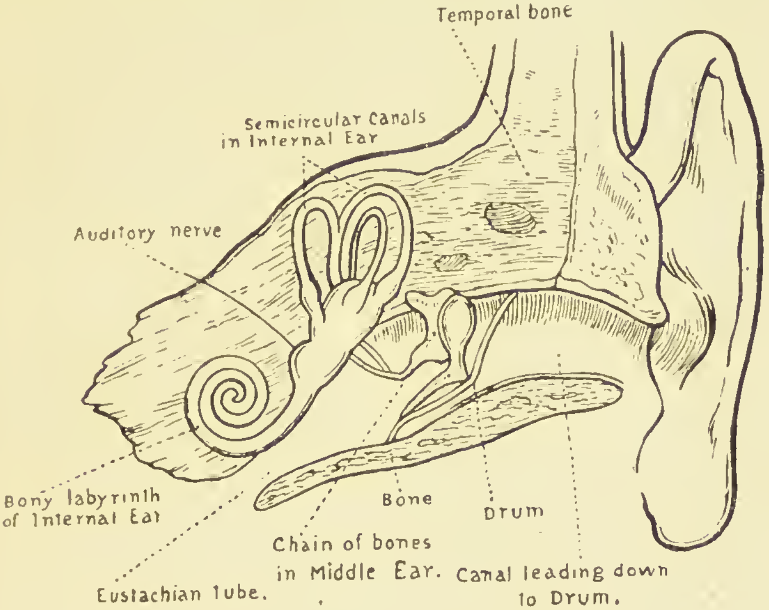
Diagram of Short-Sighted Eye.

Causes and Prevention of Short Sight.—Whilst hypermetropia is generally hereditary, many cases of myopia are due to excessive use and misuse of the eye in childhood. Myopia rarely develops before nine years of age, and amongst predisposing causes are small print and bad type, insufficient lighting, badly constructed desks, and prolonged use of the eye. Work which compels a child to bend the head and look at small objects, by congesting the eye, increases any tendency to short sight. Prevention of short sight is assisted by regular examination of the eye, and by ensuring that the rooms are well lighted, and that overpressure and excessive use of the eye are avoided. When short sight develops, suitable glasses must be procured at once, as neglected myopia is progressive, and may result in serious damage to the eye structures.

THE EAR.

The ear may be divided into—(1) The outer or external ear; (2) the middle ear; (3) the internal ear.

The External Ear, above and behind, shows the margin; the lobule below; and the lappet (tragus) in front. The external auditory canal leads inwards to the ear-drum,



or *membrana tympani*, which closes the passage. There are tiny glands in this passage which secrete cerumen, or ear-wax.

The Middle Ear is separated from the outer ear by the drum. It contains three small bones—*hammer*, *anvil*, and *stirrup*—which touch the drum and cross the chamber to impinge against the internal ear. The middle ear is connected with the throat or pharynx by the *Eustachian tube*, which allows air to enter the middle ear when we swallow. This tube is apt to be affected by catarrh, in "cold in the head," or adenoids, or sore throat, producing partial deafness, because the pressure of air is interfered with, and the drum does not vibrate properly.

The Inner Ear is deeply situated in the temporal bone. It consists of *semicircular canals* and of a "sounding board," in the form of a spiral, called the *cochlea.* Sound-waves in the ether or atmosphere impinge upon the tympanum or drum, and set it vibrating. The three small bones in the middle ear transmit the vibration to the inner ear, where the semicircular canals and the cochlea are intimately associated with the filaments of the auditory nerve, which transmits auditory sensations to the auditory centre in the brain.

Sense of Smell.—The organ of smell is the mucous membrane lining part of the nasal cavities, which is supplied with nerves from the *olfactory bulbs* or nerves (first pair of cranial nerves). By the contact with these nerves of certain particles or substances (vapours or gases) in the air, the sensation of smell is transmitted to the brain.

Sense of Taste.—Some of the endings of certain cranial nerves (the glosso-pharyngeal, etc.) terminate in *taste-buds,* oval bodies composed of epithelial cells on the surface of the tongue, the soft palate, and the epiglottis. Soluble substances in the fluid of the mouth, by their action on these buds, excite the sensation of taste. Taste is often associated with smell, giving the sensation of *flavour.*

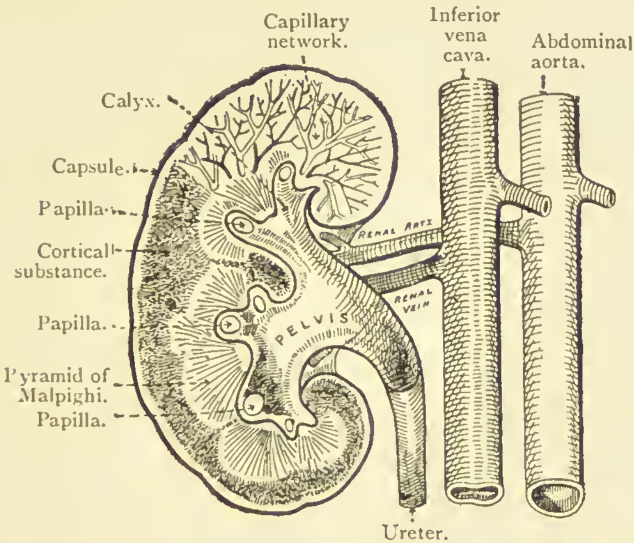
Sense of Touch.—Touch is the sense of pressure referred to the skin or surface of the body. Certain structures, nerve-corpuscles, or tactile cells, are found in the skin associated with nerve endings. The sense of touch is more intensified at certain parts of the body—for example, the lips, the tips of the fingers, etc.—and in these areas the tactile cells, or corpuscles, are numerous and more complicated. The skin is also the seat of the **sense of temperature,** which is caused by irritation (by means of heat or of cold) of the endings of the nerves.

CHAPTER XII

THE EXCRETORY SYSTEM

Structure of the kidneys—Their function—The skin—Skin glands—The hair—The nails.

VARIOUS organs are concerned in the function of excreting deleterious matter from the body. The lungs and the intestines, two organs which have to do with excretion,



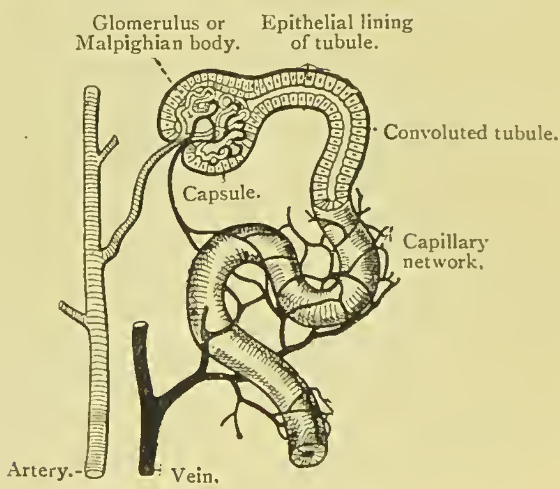
VERTICAL SECTION THROUGH RIGHT KIDNEY.
Seen from the top.

have already been considered. Other excretory organs are the kidneys and the skin.

THE KIDNEYS.

The kidneys are situated in the abdomen, one on each side of the spine in the lumbar region. Each kidney is

about 4 inches long and 2½ inches across. A kidney weighs about 5 ounces. Leading from the kidney is a tube called the *ureter*, and the two ureters open in the pelvis into the urinary *bladder*. The kidneys, like the other organs in the abdomen, are covered with peritoneum. The depression at the middle of the inner border of the kidney is called the *hilus*, and at this point the renal artery enters the kidney, conveying blood from the aorta, and the renal vein leaves the organ, carrying venous blood to the inferior vena cava. The kidney is also supplied with nerves and lymphatics. At the junction of the ureter and the kidney there is a dilated part called the *pelvis of the kidney*. If the kidney is opened, the solid substance is seen to be arranged in two layers. The outer portion is the *cortex*, whilst the more central part of the organ forms the *medulla*. The medulla is composed of a striped substance arranged in several pyramids, which project into the pelvis of the kidney. Microscopically, the kidney is made up of an



MINUTE STRUCTURE OF KIDNEY.

infinite number of minute coiled tubes. Each tube begins in the cortex in a little round body, or glomerulus. The glomeruli can be seen with the naked eye as small red dots. Each consists of a tuft of capillaries, pushed into the dilated end of the tube. This tube is lined with epithelium, and, after leaving the glomerulus, it is closely coiled, but finally

opens into a straight tube, which runs down the pyramid of the medulla, to open into the pelvis or the dilated upper end of the ureter.

THE FUNCTION OF THE KIDNEY.

The function of the kidney is to secrete urine from the blood. As the blood circulates through the tufts of capillaries—the glomeruli—water passes from the blood into the beginning of the coiled tubes. The tubules are surrounded by capillaries, and the cells lining the tubes extract salts and waste matter from the blood, which is dissolved in the water from the glomerulus, and so urine is formed. The glomerulus acts, as it were, as a flush-tank in washing out the more solid deposits lower down the tube.

Urine is a clear amber-coloured fluid, consisting of water and various salts, and a substance called *urea*. Urea is formed in the liver, and it is separated from the blood in the kidney. It is a nitrogenous material, and the amount secreted is greater if meat or other protein food has been taken.* The chief salts in the urine are sodium chloride, and various phosphates and urates. The urates are more soluble in warm than in cold water, and they may become deposited as a brick-red dust when the urine cools. About 50 ounces of water are secreted by the kidneys in one day, and about 1½ ounces of urea. In hot weather, when the skin is acting briskly, less water is passed by the kidneys. In cold weather the amount of urine is increased, because cold contracts the bloodvessels of the skin, and more blood goes to the kidneys. The solids in the urine do not vary very much.

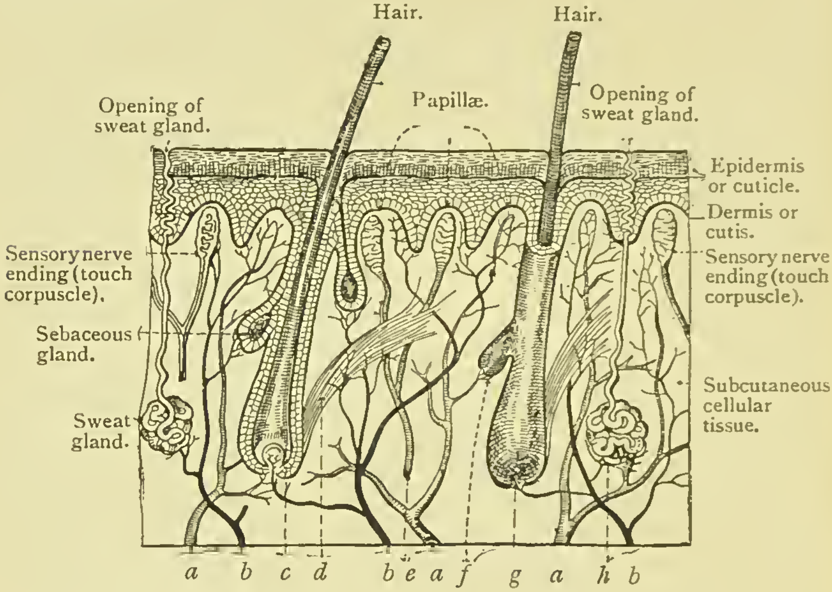
THE BLADDER.

The ureters measure about 14 to 18 inches long, and they open into the bladder obliquely, forming a tiny flap inside the organ, which prevents the passing back of urine. The bladder is a muscular bag, lined with mucous membrane, the function of which is to store the urine—which is constantly passing down the ureters—and to discharge it at intervals.

* If sufficient nitrogenous food is not eaten, urea may be extracted from the tissues, with consequent loss of weight from the body.

THE SKIN.

Whilst one of the chief functions of the skin is excretion of waste material, it serves also as a protective envelope to the body, and as an organ of touch. The skin is also concerned in the important function of regulating the heat or temperature of the body.



VERTICAL SECTION THROUGH THE SKIN (MAGNIFIED).

a, Arteries; *b*, veins; *c*, hair-bulbs; *d*, muscle; *e*, tactile nerve; *f*, sebaceous gland; *g*, hair-bulb covered by epidermic sheath; *h*, sweat gland.

The skin is composed of two layers—the epidermis on the surface, and an inner layer, called the dermis, or true skin. Beneath the skin is a loose layer of connective tissue containing fat, called the subcutaneous tissue.

The Epidermis is composed of various layers of cells; the deepest layer, called the Malpighian layer, is formed of columnar or column-like cells lying perpendicular to the dermis. These cells are continually multiplying and pushing themselves towards the next layer of epidermis, the corneous or horny layer, becoming flat as they ascend. When they reach the surface they become

more dry and more scaly, and are rubbed off by friction. The epidermis contains neither nerves nor bloodvessels.

The Dermis, or true skin, is a meshwork of connective tissue, containing white and yellow elastic fibres. It is richly supplied with bloodvessels, and with nerves, glands, and hair-bulbs. The upper surface of the dermis projects into the epidermis as conical processes or papillæ, and some of these papillæ contain an oval body connected with a nerve fibre, and structures which are called touch corpuscles, because they give us the sensation of touch; but if the epidermis is removed by accident, these bodies give us the sensation of pain.

The Glands.—If the tip of the finger is examined with a lens, rows of tiny pores can be seen along the ridges of the epidermis, which are the opening of sweat glands. There may be as many as one or two thousand or more openings per square inch. Each pore leads into a corkscrew tube, which passes through the epidermis to the deeper part of the dermis, where it lies coiled like a minute ball, forming a sweat gland. Around these coils are blood capillaries, and the cells lining the sweat glands have the power of secreting water from the blood, and so producing sweat or perspiration. Sweat consists of water, with a trace of salt and carbonic acid in it. It is constantly evaporating from the skin as insensible perspiration. During exercise or in hot weather it increases in amount, and can be seen as drops of fluid on the skin, when it is called sensible perspiration. By evaporation of perspiration the temperature of the body is lowered, and a good deal of heat is lost from the body by this means. The increase of perspiration in hot weather is Nature's method of preventing the temperature of the body from rising above the normal. The other glands in the skin are called sebaceous glands. These secrete a fatty substance, which nourishes the skin and the hairs with which these glands are usually connected.

Hairs are formed from the corneous cells of the epidermis. Each hair grows from a pit in the epidermis, called the hair follicle. In the bottom of the follicle there projects a papilla, richly supplied with bloodvessels, which nourishes the root of the hair. The cells in the follicle are constantly increasing by multiplication, and pushing the older cells

outward to form the shaft of the hair as it grows. Small sebaceous glands open into the follicle. When these are too active, the hair is greasy, dry dandruff is also produced by excess of sebaceous matter; but when the secretion is too scanty, the hair is dry and brittle.

Nails are also epidermal structures, growing as the hair does by the multiplication of deeper cells. The nail lies on a nail-bed on the dermis, which is richly supplied with bloodvessels. The body of the nail grows outwards, and terminates in an edge.

CHAPTER XIII

PERSONAL HYGIENE

Relation between hygiene, health, and happiness—The value of good habits—Fresh air and cleanliness—Parasites—Bathing——Care of the hair—The teeth—Food and drink.

Good health is very largely dependent upon hygiene, especially if the term includes mental hygiene as well as personal and home hygiene. The advantages of sound health cannot be overestimated. Every girl should regard it as a duty to maintain her health at the highest possible level. Efficient work, happiness, the power of helping others, are affected by health, and the practical study of personal hygiene will provide a very good basis to anyone who desires sound health. Amongst the essential principles of health, we must include such hygienic factors as the breathing of pure air, the eating of pure food, the maintenance of cleanliness of body and purity of mind, the obtaining of regular outdoor exercise, and the accomplishment of definite work, combined with the regulation of rest, recreation, and sleep. It is in youth that good habits can most easily be established. Every girl can determine to cultivate good physical and mental habits, which will have far-reaching effects upon health and character. Habit may be defined as the tendency to perform certain actions. We know that many actions tend to become automatic or reflex, performed without the consciousness or will of a person. When a child learns to walk he does so with infinite trouble and care and difficulty. But gradually the habit of walking easily is acquired; the act becomes almost automatic or reflex. In the same way we can cultivate any habit, either mental or physical. The habits of early rising, of daily bathing, of personal cleanliness, of good

temper, of diligence, of courtesy, can be acquired by effort and determination. Most people realise that they fail in certain respects of character, but many do not understand that practically every defect of temperament and of character can be overcome by gradually training the mind, just as many physical defects—for example, round shoulders or undeveloped muscles—can be overcome by suitable exercise and development of the muscles. To acquire any one good habit, there must first be determination or will; secondly, the power to follow day by day the training determined upon. Gradually the habit becomes a part of one, the action which was at first difficult is performed easily, without conscious effort. Thus character is formed.

We shall consider the various physical and mental habits in order, which can be grouped under the term "personal hygiene."

CLEANLINESS.

Fresh Air.—One of the first essentials of health is an abundance of fresh air day and night. Every girl should determine to live and sleep in rooms which are thoroughly ventilated, to get accustomed to open windows day and night, and to spend as much time as possible daily in the open air. Many ills of girlhood are due in part at least to lack of fresh air, and amongst these we may include headache and anæmia. Fresh air is a tonic, in that it stimulates the respiratory passages, and purifies the blood. And the first law of personal hygiene should be to live and sleep in fresh, pure air.

Cleanliness.—Absolute cleanliness of the body is, apart from its effect upon health, a habit which influences the development of character. Cleanliness is essential to self-respect. It is a safeguard, not only to one's own health, but it bears upon the welfare of others. Lack of cleanliness is a danger, in view of the fact that many diseases are caused by microbes or germs, which are more abundant wherever there is dust or dirt.

External parasites are more liable to appear on the body and hair when cleanliness is neglected.

The Pediculus capitis, or head-louse, infests the hair, and multiplies rapidly by eggs or nits. "White precipitate"

ointment will destroy the lice, and the nits can be removed by bathing the hair with vinegar and water.

The Pediculus corporis, or body-louse, is found in the clothing, and can be destroyed by ironing with very hot irons.

Scabies or Itch is a disease of the skin (commonest sites between the fingers, behind the joints, etc.) characterised by intense itching. The disease is very contagious. It is caused by the itch mite (*Acarus scabiei*), the female of which burrows into the epidermis to deposit her eggs.

Treatment consists in frequent hot baths and scrubbing with soft soap, followed by applications of sulphur ointment. The clothes must be disinfected with boiling water.

Ringworm is a contagious disease of the body or scalp caused by a fungus. It is treated by applications of tincture of iodine. (For Internal Parasites, see p. 142.)

Cleanliness of the skin is a preventive also of skin affections. For example, *acne*, the signs of which are blackheads and pimples, is caused by a blocking of the ducts of the skin glands; dust accumulates in the pores, producing blackheads and various inflammations or pimples, resulting from the irritation and the action of germs. Brisk friction of the skin and absolute cleanliness are essential parts of the treatment of this ailment, which is fairly common in girlhood. Cleanliness of the skin means thorough washing of the whole body once daily, followed by friction to stimulate the circulation and to remove all dust which may have found its way into the pores. Most girls will find that a tepid bath, followed by a cold sponge with a loofah or bath-brush, is the most satisfactory. A warm bath helps the system to get rid of various poisons from the skin, but the after-application of cold water is necessary in order to get a reaction, and to ensure contraction of the skin vessels, which is a safeguard against chill. There is some risk in the habit of taking a cold bath every morning, irrespective of season or of condition of health. The effect of cold water is to drive the blood from the skin to the interior of the body. And no girl should persist in taking cold baths if she does not have a sense of exhilaration and warmth afterwards, which means that the blood has flowed back to the skin in reaction.

Sea-Bathing is healthful, provided it is indulged in under sensible conditions. It is injurious to the person who stays too long in the water, who bathes immediately after a meal, or when fatigued with exercise, or when the body is cooling after perspiration. The best time to bathe is at 11 a.m., when breakfast is fairly well digested and the sea and air are warmed by the sun. A quick bathe of four or five minutes, followed by a brisk rub down and a little exercise afterwards, ought to have the best results.

Care of the Hair.—Regular cleansing of the scalp will promote the growth of hair and prevent it coming out, as it may do even in youth if the hair is neglected. The hair should be brushed every night with a clean, moderately stiff brush, and should be carefully combed, so that there can be no tangling or breaking of the hair. The scalp must be washed once in three weeks with warm water and a liquid soap, consisting of equal parts of soft soap and rectified spirit. If 6 ounces of this mixture is purchased, the amount should last for two or three washings. The hair should be dried in the sun if possible, or else with hot towels, and care must be taken to thoroughly dry the hair before going to bed.

The Teeth must be washed and brushed several times a day, if possible after every meal and at bedtime. It is not sufficient to brush the front of the teeth. They must be thoroughly brushed back, front, and crowns, moving the brush up and down as well as across the teeth, scrubbing the gums also at the same time. Any simple antiseptic tooth-paste or powder can be used. The scrubbing not only cleanses the teeth, but it brings more blood to the jaws, which prevents decay. The teeth ought to be regularly examined by the dentist, so that any necessary stopping may be done and decayed stumps removed. Proper care of the teeth is a very real preservative of health, as bad teeth not only mean that the food is improperly chewed, but poisons are all the time being absorbed into the system, causing anæmia, lassitude, and headache.

FOOD AND DRINK.

The subject of dietetics has already been considered, and little need be added under this section on personal hygiene. The importance of thorough chewing, of regular meals, of

moderate eating, need not be emphasised again. The value of temperance, both with regard to food and drink, is very great. The girl who over-indulges herself with sweets and cakes has to pay the penalty of a sluggish complexion and impaired digestion, and the taking of strong tea and coffee will have the same effect. Whilst it is unnecessary, after what has been said in the chapter on beverages, to repeat that indulgence in alcohol is a very real menace to health. Apart from the direct effect upon the organs of digestion, the liver, the brain, and the nervous system generally, of alcohol in excess, intemperance is a habit which causes serious deterioration of character. No young person should ever take alcohol without the direct advice of a doctor.

It would seem unnecessary to warn girls against the use of narcotics, or the abuse of tobacco. But I have known girls who have developed a habit of taking narcotic drugs such as opium, the habit having been established when the drug was taken to relieve neuralgia or sleeplessness. It is absolutely fatal for a girl to get into the habit of taking narcotics. And, indeed, the only plan is to make a rule that no drugs ought ever to be taken, except perhaps a simple aperient, without medical advice. Girls also should be alive to the risks of drugging, or smoking in excess, where other people are concerned. Nicotine is a poison to the nervous system, and excessive smoking will injuriously affect the heart and eyesight as well as the brain.

CHAPTER XIV

PERSONAL HYGIENE—*Continued*

Exercise—Mental work—Rest and sleep—Special hints for girls—Recreation—Eugenics.

THE subject of physical exercise will be considered in the Physical Training section. Regular exercise is one of the essential principles of health. In exercise, poisons are quickly got rid of from the body, and more oxygen is taken into the lungs, absorbed into the blood, and carried to the tissues. Under this heading the question of graceful deportment must be touched upon. Every girl should learn how to stand properly, gracefully, and easily, and how to sit so that the lower part of the spine is supported by the chair-back, and the feet are resting gently on the floor. Many girls get into the habit of sitting ungracefully, or sitting in a tense way, so that the feet are pressed hard against the floor, the hands clenched, the brow knit, and real *rest* is practically impossible. The girl who cultivates correct posture saves her vitality, and is less fatigued nervously and mentally in consequence.

Mental exercise, or intellectual work, is another factor in personal hygiene. A girl must do a certain amount of mental work if she is to keep in health. There are very real dangers in idleness. In the first place, a girl who has "nothing to do" dissipates her energies in the futilities and trivialities of life. If she has not got some real work on hand, she may spend her energy on undesirable occupations, or gradually come to find idleness supportable. This is the beginning of deterioration of character. Every human being should be expected to do a certain amount of useful work, and those girls who do not require to work for

economic reasons of self-support will find ample work on the lines of social service, which calls for so many helpers at the present time.

SLEEP.

Sleep is a natural physiological process, essential for recuperation and repair. It is during sleep that we get rid of the waste products of fatigue, and are enabled to store up new energy. The girl who is working hard and having her proper allowance of outdoor exercise should be in bed at 10 p.m., and rise at 7 a.m. or a little later. She should have at least nine hours' sleep every night. Very few girls are troubled with sleeplessness, but many do not sleep as soundly and as restfully as they might. Certain conditions promote restful sleep—for instance, a well-ventilated bedroom, a comfortable bed, with sufficient but not too many blankets, a restful attitude of mind. Most girls find that they sleep better if they do not study too late at night. Late supper is apt to cause sleeplessness, but a glass of hot milk at bedtime is often an excellent thing for a girl who has had to do a few hours' study after the evening meal. One has to make the best of circumstances. And the girl who has examinations in prospect must often work until 9 or 10 p.m., although mental work after seven o'clock is undesirable from the hygienic standpoint. It is essential to get into a habit of regular bedtime and regular hours of restful sleep. The habit of insomnia is very easily developed even in youth, and the consequence of irregular and late hours when a girl is working hard and probably growing rapidly are very serious.

THE EYES.

From what has been said of the physiology of the eye, it can readily be understood that eyestrain will injure health and handicap the power of work. Headache and depression of spirits are often caused by eyestrain, and it is essential, if defective vision is suspected, to have the eyes examined by a properly qualified oculist, and to obtain suitable glasses if necessary. Apart from errors of refraction, considered in an earlier chapter, girls must guard against straining the eyes by excessive study, or by reading in a bad light. The condition of the eyesight is partly

influenced by the general health. So that measures directed towards the preservation of health and of vitality will make the eyes "stronger," and will enable a girl to do more mental work without risk to her sight. It is, of course, very necessary that the slightest error of refraction should be corrected by suitable glasses.

SPECIAL HINTS FOR GIRLS.

Whilst every girl should guard against chill or unnecessary health risks at any time, special care should be exercised during the three or four days each month when the danger of chill is especially great. Serious inflammation may result from wearing wet boots and neglecting to change wet clothes at this time. And it is equally important to avoid excessive physical fatigue, such as results from hard hockey playing, or indulgence in any game to the point of fatigue. Whilst most girls do not experience any adverse symptoms during this period, others may feel less fit, physically and mentally, and it is certainly advisable in these circumstances to avoid excessive mental strain, and to rest as much as possible. Cold baths ought not to be taken, and during the first day or so a cold sponge should be omitted, bathing being utilised simply for cleansing purposes. At the same time, there is no reason for any girl of normal health to alter the day's routine or to give up her usual work or recreation.

RECREATION.

The girl who works hard must have her due measure of recreation. The proper balance of work and recreation is one of the principles of health; the cultivation of hobbies goes far to make work more enjoyable, and leisure more profitable. An outdoor hobby has special advantages in that it takes people into the fresh air. But the great thing is to choose a hobby which appeals specially to one's temperament, whether it may be tennis, stamp-collecting, photography, or gardening. It is one's duty to cultivate the capacity for enjoyment, the ability to find happiness in the simple pleasures of life. Cultivation of happiness is a duty, because it not only makes for personal health, but it adds to the welfare and pleasure of the people one comes in contact with.

EUGENICS.

We have heard a good deal of late years about our duty to other people, to the general community, and to the race. A new science called " eugenics " has come into existence. Human beings are the products of two conditions—nature and nurture. Nature, or heredity, is the endowment each individual receives from his ancestors. Nurture is comprised in the environment, the food, training, education, we are given from the day of our birth to youth or adolescence, or even to well on in adult life. A healthy heredity is the birthright of generations to come, and eugenics is the science concerned with good breeding or race culture, by encouraging healthy and worthy parenthood and the better care of offspring, and by preventing as far as possible the propagation of " unfit " human beings. The idea that girls and boys should be trained in hygiene and physiology is already accepted. Young people should be taught how to preserve health and to prevent disease. Girls should be given simple teaching in the care of their own health, and some training in the management of children, because, whilst all girls will not become mothers, few women go through life without having had something to do with the care of children. And so a later section of this book will include the principles of child management and hygiene in the nursery. The eugenists believe that boys and girls should be trained for good parenthood. They should be given high ideals concerning their duty in this respect, and taught that health of mind and body in youth will make a great difference to them and to their children in after-life.

CHAPTER XV

THE HOUSE OR DWELLING

Situation—Soil—Construction—Ventilation, warming, and lighting—Water-supply—Springs, wells, rivers, lakes—Filtered water.

THE consideration of Home Hygiene is of first importance. With regard to the dwelling-house, many points have to be studied, including soil, aspect, construction, furniture and decoration, ventilation, warming and lighting, as well as water-supply, drainage, sanitation, and the removal of refuse.

SITUATION.

In order to get the most sunlight for the living-rooms of the house it is necessary that the main fronts face south-east and north-west. In the height of summer the four sides of the house will consecutively receive sunshine, and because the south-east and south-west will have the largest allowance of sun, the sitting-rooms should be situated at these aspects, whilst the larder and the bed-rooms which are occupied at night should be placed at the other aspects of the house. For people who have to live in a street or terrace, the best situation is obtained if the house faces east and west. Houses that are built back to back must be avoided, as it is necessary that there should always be plenty of open-air space at the back of the house, and at the front and back doors. The aim should be to procure as much air and light as possible. For this reason it is not wise to choose a house lying in a hollow. The slope of a hill is an excellent situation, and whilst trees in the immediate vicinity are an advantage especially to the north, they should not be permitted to grow close up against

a house. It is important to note that the prevailing winds, south and south-west, do not bring smoke from factories, offensive trades, etc.

SOIL.

The healthiest soils are those which are porous to some depth; and it is always necessary to discover if the ground upon which the house is built is well drained. Houses are in a sense suckers, in that they draw (because the air in the house is warm) any gaseous matter, such as sewer gas or coal gas, from the ground, or foul air from cesspools, this action being increased in winter when the outside ground is frozen. It is of great consequence to attend to the *surface* water, which collects chiefly on clay soils, thus causing a damp surface. Wherever we have a dry soil there is less likelihood of lung disease in that neighbourhood. An important point is to avoid "made ground" in choosing the site of a house. In many districts, especially on the outskirts of large towns, soils are built up of all sorts of sweepings and refuse, which contain germs and organic matter, and then houses are built upon these sites. So that it is necessary to remember that clay soils and "made ground" are both unhealthy, because they retain the damp and the germs of disease. The best soils from the sanitary point of view are deep gravel, chalk, loose lime, stone, loose sand, with permeable subsoil.

CONSTRUCTION AND VENTILATION.

In building a house one of the first essentials is to exclude damp. The foundations, therefore, should be laid on concrete, and the basement should be isolated. A damp-proof course can be inserted into the brickwork in the outer wall, about 6 inches above the external ground-level, and below the floor joists. This prevents the ascent of dampness in the walls of the building. A good damp course consists of sheet lead laid on the full width of the wall, or slates set in Portland cement.

The Walls should be constructed of materials that will not readily allow wet to permeate them, and that are bad conductors of heat. They should be built double, with an interspace, especially if they are made of bricks, and the inner wall should be covered with plaster; whilst if the

outer wall is of good brick, covering is unnecessary, but otherwise it should be covered with Portland cement. If ventilating bricks are inserted just below the level of each floor, continuous ventilation is provided, and the floors and ceilings are protected from dry-rot.

The Roof should be constructed of tiles, slate, or lead, so that water runs easily from it. If the roof is lined by felt or wood, and if in the top rooms a flat ceiling of lath and plaster is added, cold and heat are to a large extent excluded.

FLOORS.

A well-built house has floors that are toughened and well made, and that are built in such a way that there is no room for débris to fall through and collect between the floor and the ceiling below. Concrete floors are best from the sanitary point of view, and, in basements, the floors should be bedded in pitch to prevent dry-rot, or on wood blocks or concrete, the blocks being set with pitch.

The Ventilation of rooms has already been considered (see p. 55). Staircases and passages must be ventilated independently of rooms, also water closets and housemaids' closets, etc., and these should be situated against an outer wall. In building a house the windows should be made as large as possible, and reach nearly to the ceiling, and they should open top and bottom. The best aspects for windows are south, south-west, or south-east. A fireplace should, if possible, be built in every room.

WARMING AND LIGHTING.

The well-lighted home is cleaner and more hygienic, because sunshine finds out dusty corners, and these offer harbourage to microbes. Sunshine is a disinfectant, in that it destroys the germs of disease, and the rule should be to admit as much light as possible into the home. As to artificial light, electric light is hygienic, as it does not use air in the sense that gas or lamps utilise a large amount of oxygen and produce carbonic acid gas. Careful ventilation should be attended to in rooms where artificial light has to be used. In warming a house, the various advantages and disadvantages of open grates, stoves, and gas fires have to be considered. Economy can be

assisted by utilising some of the modern contrivances for introducing fuel into the bottom instead of the top of the grate. In building, the idea should be to place fireplaces near the centre of the house. Provision must be made for ventilation, when stoves are used in halls or passages. The modern combustion grates are more hygienic and more sanitary than the old-fashioned fireplaces, which allowed most of the heat to pass up the chimney. Modern grates are nearly all of fireclay. A good modern fire-grate should have the back and sides made of fire-brick, and have a layer of fire-brick at the bottom of the grate. It is an economy if the grate is lowered so that it lies on a bed of fire-brick, at, or below, the level of the floor. The width of the back of the grate should be about a third the width of the front, the sides sloping outwards.

The depth from before backwards should be equal to the width at the back.

If the entrance to the chimney is contracted, it insures more complete combustion.

Electric stoves and radiators are now being introduced for heating purposes.

Hot-Water Pipes are used for heating large houses, schools, and institutions. Heating may be carried out by the *low-pressure system*, which has a boiler from which water circulates through the pipes throughout the building, returning to the boiler cooled. The water is kept at a temperature of not more than 200° F., and so there is very little pressure on the pipes. *The high-pressure system* has no boiler. Part of the tube passes through the fire, and the water is heated to 300° 350° F. Thus there is great pressure on the pipes, which are made with thick walls consisting of two pieces of welded iron.

WATER-SUPPLY.

The subject of drinking-water is also considered in Chapter XVIII. With reference to home hygiene, it is necessary to add something about the source of the water-supply and its storage.

In country districts the water may be obtained from the **rainfall.** In such cases dust and débris from the roof are apt to be carried into the tank. Some of it floats on top,

and can be removed from time to time, but a certain amount remains suspended or dissolved in the water. Various contrivances are on the market for excluding the dirty washings from the tank. Robert's rain-water separator is an apparatus which can be attached to the rainfall-pipe for directing the first part of the flow away from the tank-fall. After a time the small compartment, as it fills with water, "cants over" and directs rain into the tank. Another objection to rain-water is, that besides being apt to get dirty, it is too soft to be palatable, and in country districts, as a rule, the water-supply is derived from springs or wells.

Upland Surface Water is the source of many large towns, for example, Birmingham and Glasgow. The water from the surrounding hills is collected at the bottom of a valley in a lake (either natural or artificial). The water is soft. It may be slightly brownish in colour from the presence of peat, which exerts no ill-effects; and in some cases (if the water is acid in reaction), it has been found that upland surface water has dissolved a certain amount of lead from the lead service pipes. Lead pipes lined with tin with an intervening layer of asbestos have been used in such cases, and it is found that the power of dissolving lead is removed by passing the water over filters of sand, spongy iron chalk or limestone.*

Springs.—The water from this source is really rain-water, which passes through the soil until it reaches an impervious stratum, such as clay. At the top of this stratum it collects, and it frequently runs along until it can emerge as a spring on the surface of the ground. Spring-water is apt to be hard, because the rain, as it passes through the rocky soil, dissolves mineral matters, especially carbonates, but deep spring-water is, as a rule, excellent drinking-water.

Wells.—The value of wells as a source of drinking-water depends upon their depth. *Surface wells* are those which only extend downwards through the soil to tap the water held by the first impervious layer, and the danger is that they are apt to be contaminated with sewage. Thus it is important that no cesspools, middens, pigstyes, etc., are allowed to be in proximity to the wall. A *deep well* is

* Hygiene and Public Health. Arthur Newsholme, M.D.

tapped through one impervious layer to tap water held up by the second impervious layer.

Artesian wells are made after lining a surface well with brickwork, set in cement, by boring through the rocks until a water-stratum is tapped. Artesian wells are often several hundreds of feet in depth, the water overflowing at the surface. The water is generally palatable, and may be sparkling from the presence of carbonic acid gas. Well-water is generally hard from the presence of carbonates.

Rivers and Lakes are often used as water-supply. This source of water is dangerous when pollution with sewage occurs. In the event of large towns being supplied from rivers or lakes, every care is exercised to prevent contamination.

How Water is contaminated.—Water may be contaminated from the sewage of towns, as in the case of rivers and lakes. It can also be contaminated by percolation through the soil from cesspools, débris, etc., as may happen in the case of surface wells. Water may, of course, be directly contaminated by disease germs through carelessness, the fomites (discharges and excretions from the patient) being allowed to come in contact with the water-supply. The idea that filtering water renders it perfectly safe to drink is very common. But when one is at all suspicious of the water-supply, boiling is the only unfailing safeguard. The old-fashioned filter, even when it is perfectly clean, cannot prevent the passage of disease germs, and it is these invisible poisons in the water that are the real danger. We are all becoming more alive to the importance of a pure water-supply. This question is the one essential thing to investigate before taking a house or even going into rooms for a holiday. People who have been living a long time in a house may not derive any harm from the contaminated drinking-water, because they have become more or less immune to the poisons it contains; but strangers, being "virgin soil" for the microbes, may contract serious illness.

Mineral waters of known purity should be drunk when there is any suspicion that the water-supply is not good, and when distilled water cannot be procured.

The Rivers Pollution Commissioners give the following classification of the various waters in their Sixth Report:

Wholesome -	1. Spring Water 2. Deep-well water 3. Upland surface water	very palatable.
Suspicious -	4. Stored rain water 5. Surface water from cultivated land	moderately palatable.
Dangerous -	6. River water to which sewage gains access. 7. Shallow-well water	palatable.

Storage and Delivery of Water.—When towns have to be supplied with water, it is necessary to provide a *collecting reservoir,* which is usually a natural valley below the level, of the source of the water, but above the level of the place supplied, so that the water may be distributed by gravity. Water may be carried from the reservoir either to a second service reservoir (or to tanks) or directly by a cast iron aqueduct or conduit into service pipes. If the water-supply is from a river, it is passed over filtering beds and pumped into raised tanks, from which it is delivered.

Constant and Intermittent Services.—The pipes bringing water to the house may be kept constantly supplied with water (which is more desirable), or the water may only be supplied at intervals. In the latter cases cisterns or water-tanks are used to store the water in the intervals of the flow.

Cisterns may be constructed of iron, zinc, stone, glazed earthernware, or brick lined with Portland cement. A cistern must have a well-fitting lid to prevent the entrance of dirt, and it must be well ventilated and easy of access, so that it may be regularly cleaned out. The overflow pipe should open into the external air, and should not pass into any part of the water-closet apparatus or the soil-pipe, because of the danger of the passing backwards of foul gases.

CHAPTER XVI

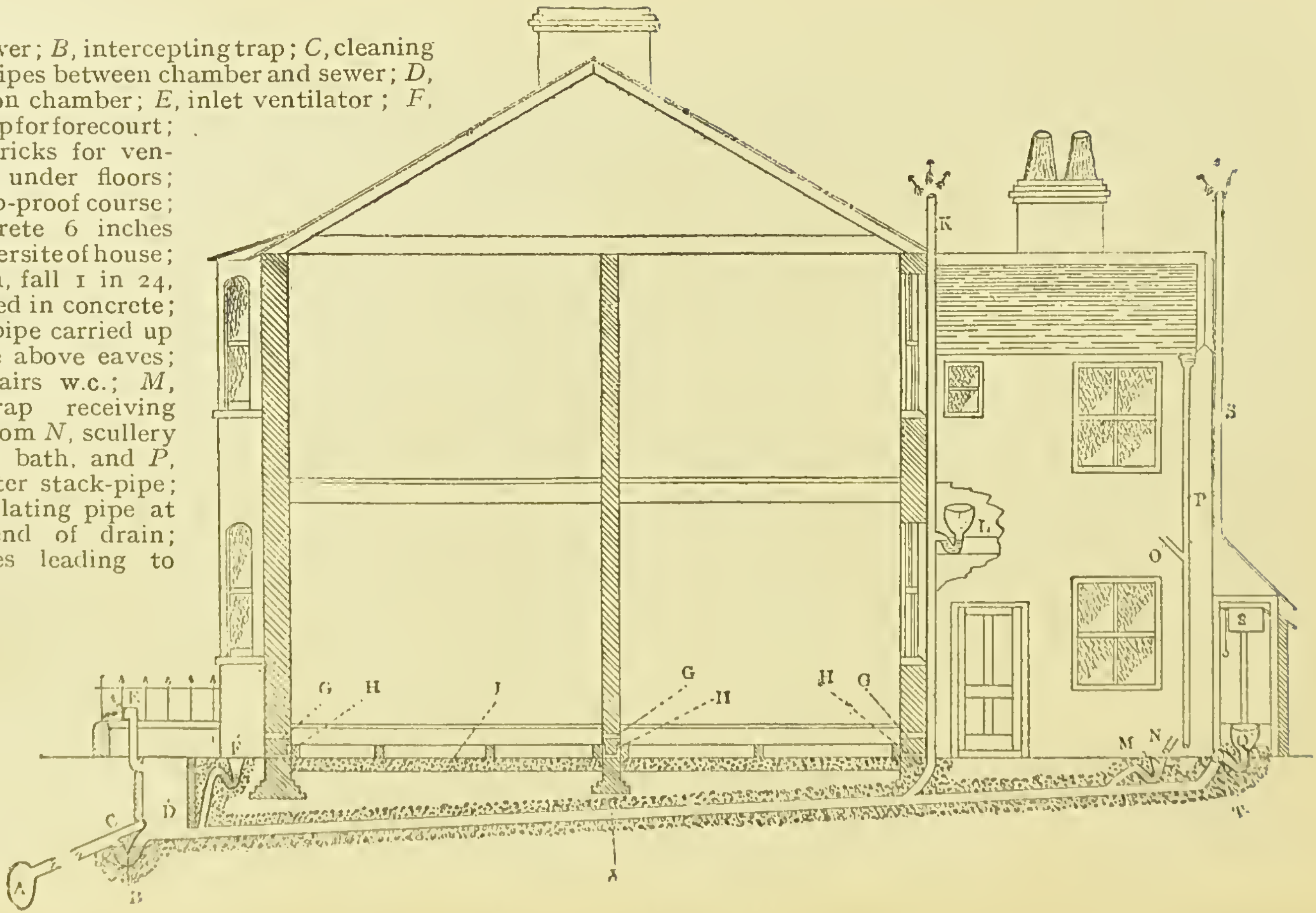
DRAINAGE AND SANITATION

House-pipes—The drain—The soil-pipe—Closets—Urinals and Latrines.

THE object of drainage is to carry away liquid refuse, excreta, and water from the house. This must be done in such a way that the air of the sewer and of the drain does not gain access to the dwelling-house. Drainage is accomplished by means of pipes, which must be impervious, self-cleansing, and efficiently "trapped" and ventilated. The use of a trap is to prevent the entrance of foul air to the house by interposing a layer of water. The trap is a U-bend of such a curvature that water lies in the U, and prevents air and gases from passing up, whilst permitting a free flow of water down, and it does not syphon out in discharging. The soil-pipe from the water closets is the only pipe to directly enter the drain, and should be continued full size above the eaves of the house away from any windows; this produces an outlet ventilation for the drain. All other house-pipes must discharge into the open air, to be conducted to a yard gulley. Pipes from lavatory basin and bath should discharge into an open spout-head, with the down spout leading to a gulley-trap in the yard.

The various house-pipes connected with house sanitation are—(1) the cistern overflow and rainfall pipes; (2) waste-pipes from lavatories, baths, and sinks; (3) the soil-pipe, the water flowing from them into other channels connected with the cesspool or sewer.

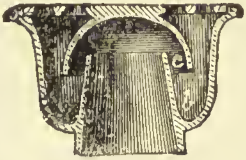
The House-Drain removes waste-water, etc., to the sewer, which is a large drain into which the contents of the house-drains in the locality enter, an intercepting trap being placed between the drain and the sewer. The house-



A, Sewer; *B*, intercepting trap; *C*, cleaning eye for pipes between chamber and sewer; *D*, inspection chamber; *E*, inlet ventilator; *F*, gully trap for forecourt; *G*, air-bricks for ventilation under floors; *H*, damp-proof course; *I*, concrete 6 inches thick oversite of house; *J*, drain, fall 1 in 24, embedded in concrete; *K*, soil-pipe carried up full size above eaves; *L*, upstairs w.c.; *M*, gully-trap receiving water from *N*, scullery sink, *O*, bath, and *P*, rain-water stack-pipe; *S*, ventilating pipe at upper end of drain; *T*, pipes leading to same.

DRAINAGE PLAN OF A MODERN HOUSE.

drain is generally constructed of glazed stoneware with cemented joints. Unless the joints between the pipes are properly made and water-tight, sewage will soak into the ground. In laying a drain it must have a firm foundation and a sufficient fall. The house-drain should pass externally to the house. If the drain has to pass underneath the house, it must lie on a concrete bedding beneath a concrete basement, or else run along one of the foundation walls in the cellar in iron pipes, the joints caulked with lead, when it can be more easily inspected if leakage is suspected. A ventilating trap should be inserted at the point before the drain enters the sewer. Buchan's ventilating trap or Doultan's trap allows of ventilation and exposure for cleaning purposes. A manhole at this point serves as an inspection chamber and fresh-air inlet. The old-fashioned D-trap, which is still in use, is very insanitary, because it is not self-cleansing, and therefore filth accumulates within it. The bell-trap is another insanitary form of trap, used for sink-pipes and yard-drains. It is so named from the bell-shaped piece of iron fastened to the under side of the grating, which is apt to get broken off (when it is not a trap); filth also collects at the bottom of the box. Everything opening into the house-drain must be efficiently trapped and, with the exception of the soil-pipe, aerially disconnected from the house.

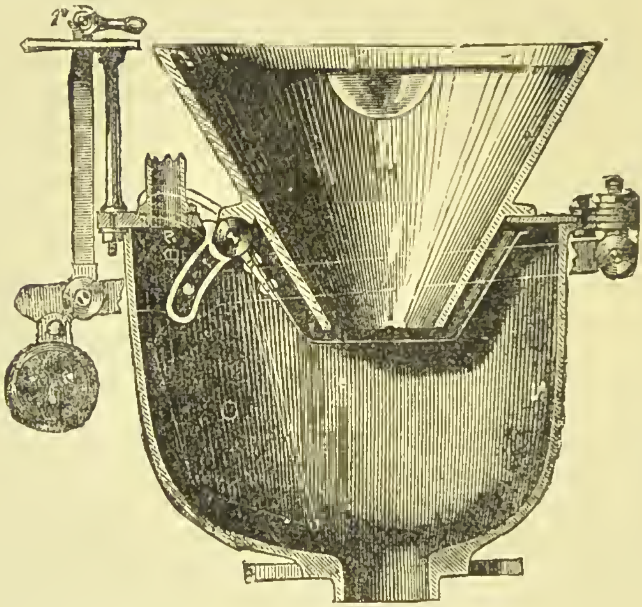

Section of a Bell-Trap.

The Soil-Pipe is the pipe into which the water closets discharge. It should be placed outside the house, and should be ventilated by a pipe of the same diameter carried above the level of the roof. It is extremely dangerous to have a soil-pipe inside the house or built into the wall, because if the piping gets corroded or riddled with holes, or if the joints leak, sewer gas passes into the house. The soil-pipe may be made either of lead (when it should be drawn lead with longitudinal seams) or iron, which is apt to rust unless it is treated with Angus Smith's solution.

The Water Closets, which, as we have said, discharge into this pipe, must be water-trapped, and the closets should be cut off from the air of the house if possible

by cross ventilation. There are various types of water closets, which are either mechanical or of the automatic type.

The Pan Closet is a very unhygienic closet. The receptacle is closed below by a hinged pan, into which the lower end of the receptacle dips. Below the pan is a large box called the container, from the bottom of which passes a 3-inch pipe to a D-trap, which is connected by a lead pipe



TRANSVERSE VERTICAL SECTION OF A PAN-CLOSET.

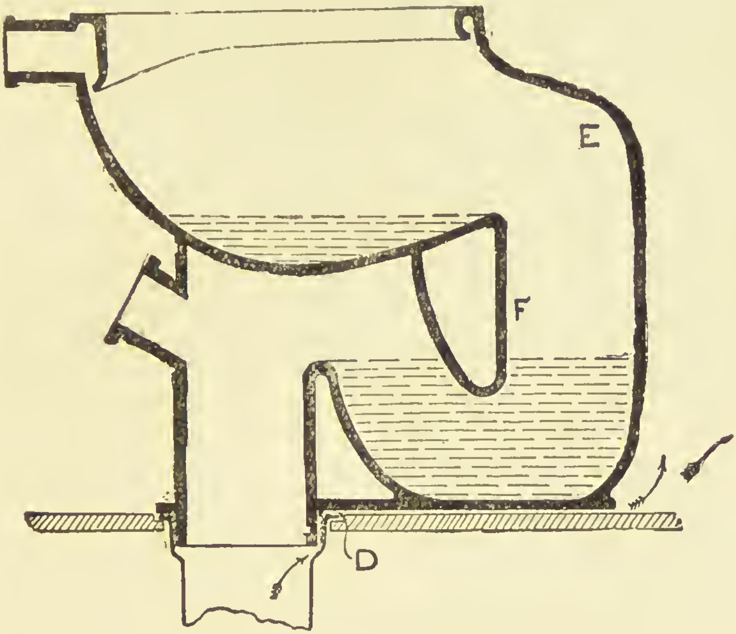
with the soil-pipe. Filth and foul gases inevitably collect in the container, making this form of closet extremely unhygienic.

The Long Hopper Closet is a conical-shaped basin, which is apt to get coated with excreta. It is a very undesirable form of closet. It is generally made in two parts, and the joint soon leaks.

The Valve Closet is better than either of the two mentioned. The basin is closed by a water-tight flap valve. There is no container. On raising the handle the valve is swung back. The contents of the basin should discharge into a sliding trap, to pass to the soil-pipe. An overflow

pipe should be provided, which must be trapped as it joins the valve-box. This closet is, however, very complicated, and closets should be as simple as possible.

Wash-Out Closets were formerly considered good types of water closets. They are made in one piece, of a very simple mechanism. The bowl is very narrow, and so shaped that it contains a small quantity of water. By means of a flushing arrangement the contents of the bowl,

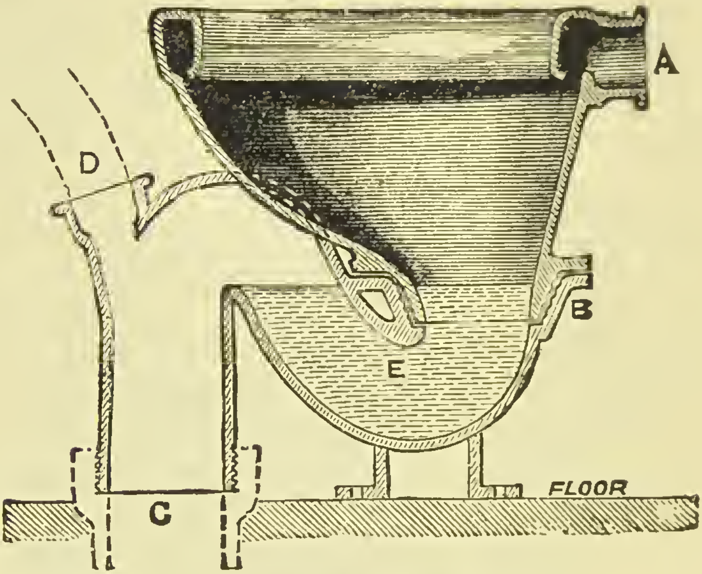


"WASH-OUT" CLOSET: BASIN AND TRAP IN ONE PIECE.

or basin are driven into the trap to pass to the soil-pipe; but it was found that the excreta fouled the back of the pipe, cracking the glaze and causing foul smells.

Then we had the most simple and effective one yet made, the *Wash-Down*, a pedestal made in one piece, with an anti-siphon pipe at the top of the trap to prevent siphonage, a 2-gallon flush clearing the trap efficiently. This water closet, with variations of the same principle by different makers, still reigns supreme. The anti-siphon pipe, especially with one closet above another, is a most important part of the mechanism; if this were not used, the

flush from one closet would siphon the water out of the other trap. The same thing applies to a series of lavatory basins.



WASH-DOWN CLOSET.

The Earth Closet and Charcoal Closet are methods of dealing with excreta when no water-drainage system is available. The closets are made with a hopper, so that a certain quantity, about $1\frac{1}{2}$ lbs. of dried sifted earth is distributed upon the surface after each use of the closet. Clay, loam, peat, and brick earth are the best soils. These forms of closets are used in rural districts. They are inexpensive and diminish the amount of water required by a household, but they are unsuited to large towns. Charcoal is a deodorising agent. It may be used instead of dried earth.

Urinals should be supplied with a liberal amount of flushing water. They should be constructed of glazed stoneware or of enamelled iron. The exit pipe should be trapped, and the pan should be kept scrupulously clean. They are unnecessary in a house, and best dispensed with.

Latrines are used in large institutions, factories, etc. The usual arrangement is to have the seats placed over

a trough containing water, connected at one end with the drain through the siphon trap, and at the other end with Field's automatic flushing tank, which automatically flushes the trough at stated periods, regulated by the amount of water running through the tap filling the tank.

Removal of Refuse.—In most towns, at the present time, the water-carriage system is used, but in neighbourhoods distant from the sewer-dry systems are still largely used. The cesspool system is used in country places, and every care should be taken to render cesspools water-tight by laying them of brick set in cement, lined with cement, and covering the outside with puddled clay. They must, further, be situated as far as possible from the house and frequently emptied, and provided with three openings: (1) access to clean; (2) for ventilating; (3) for pump to empty liquid. The Bell system of removing refuse is in some respects superior to the cesspool system. Galvanised iron pails are utilised in country districts, and moved every week, and the excreta is mixed with ashes in many cases, in order to make them as dry as possible. The dry earth closet system is an improvement upon the Bell system.

CHAPTER XVII

HOUSE DECORATION AND FURNISHING

Overcrowding—Floor coverings and wall-coverings—Removing the dust—Draughts—Methods of cleaning—Arrangement of rooms—Bedding and bedclothes—The kitchen—The fly danger—Removal of domestic refuse.

WITHIN the last ten or a dozen years the evolution of artistic taste, as well as of hygiene, has determined an era of simple furnishing and simple house decoration. The overcrowded sitting-rooms and bedrooms prevalent in the Victorian era are no longer considered either hygienic or in good taste. The modern home is simply and even sparsely furnished, luxurious only in the sense that the furnishing consists of artistic materials and beautiful objects, whilst it conforms to hygienic demands. The old styles of two hundred years ago have been revived, and washable materials—chintzes, cretons, and linens—replace the brocades, plushes, and serges utilised all through the Victorian age. People are adopting parquet flooring, or floors of polished wood, with one or two fine rugs, in place of the old-fashioned carpet.

Walls are not overcrowded with pictures, brackets, plates, and odds and ends. A room is considered better furnished with three or four pictures than with a dozen or two, and photographs, fans, and brackets which collect dust and microbes are fortunately no longer fashionable.

At the same time, the majority of people have not yet reached the ideal hygienic standard. The cult of simplicity is unfortunately restricted, and the microbe holds sway in too many homes at the present time. The rule should be to dispense with unnecessary articles as far as possible. "Ornaments," are superfluous, even in the

artistic sense, because most rooms would look better if furniture and ornaments were reduced 50 per cent., and the result would be more space, less dust, and less work for the domestic staff.

Floor-Coverings and Wall-Coverings.—The parquet or linoleum flooring, as we have said, is the best foundation from the hygienic point of view. Carpets should not, at least, be nailed to the floor, but consist simply of squares laid on a washable foundation, so that they can be removed regularly for cleaning purposes. There are many new forms of cork linoleums, perfectly inoffensive from the artistic point of view, which are preferable for nurseries and bedrooms to any carpet, if the floor is not good enough to polish. One or two rugs shaken daily give the appearance of comfort, and are not objectionable in the hygienic sense. Walls should, whenever possible, be washable, and in bedrooms, nurseries, and dining-rooms self-coloured, painted, or distempered walls, although sometimes more expensive in the first instance, are just as economical in the end, and infinitely more hygienic than any paper. If a wall-paper is chosen, it should be self-coloured. White is the best paper, because it shows up the dust, whilst many people are using distemper with excellent effect in rooms and corridors.

REMOVING THE DUST.

If simple furnishing is the first step in achieving a hygienic home, the proper disposal of dust is very important. In the sparsely furnished apartment there is less room for dust, which settles inevitably behind pictures and ornaments, in over-crowded corners, and wherever there is a crevice or a ledge for it to lie. The amount of dust in a room furnished with stuffy chairs, heavy hangings, and a thick carpet which month after month allows dust to permeate its meshes, is much greater than one might suppose. Unless some form of vacuum cleaner is efficiently used, dust is never properly removed, save at cleaning times once or twice a year. Broom and duster flick most of it from place to place, stirring it from table-tops and mantel-shelves into the atmosphere of the room. This dust can be seen distinctly, when a beam of sunshine passes into a rather dark room, as minute, ever-moving particles in the

air. Hygienic floor-coverings, washable curtains, and chair-covers of smooth material, will prevent dust finding its way into the corners, and through the material covering chairs and couches. The day of the broom and duster is passing, and very soon every housewife will use a small vacuum cleaner, so that the dust can be daily collected and burned. The dangers of dust must be self-apparent to anyone who has studied simple hygiene and physiology. The dust harbours microbes, which find their way into the throat and lung passages, and they can gain access to the body in other ways, being absorbed through the digestive tract for instance. Germs will also enter the body through abrasions in the skin, and some of the most dangerous of all germs, including the tetanus bacillus, are frequently found in dust. The diphtheria bacillus can live for quite a long time in dark and dusty corners, and every student of hygiene knows that the tubercle bacillus, or germ of consumption, is found in insanitary homes, and thrives wherever airless rooms with heavy curtains and closed windows are to be found.

Draughts.—The old-fashioned fear of draughts was responsible for maintaining an unhealthy atmosphere in many homes. Draughts are really currents of pure air which help to sweep away the microbes of disease. When the vitality is depressed, after an illness, or in old age, for instance, it is undesirable to expose people to draughts of cold air. But the ordinary healthy person should be able to live and thrive and enjoy draughts, whilst those who object to them will find that ventilation by the Hinckes-Bird or other systems already described (see Chapter VIII.) will provide them with fresh air without draught.

Methods of Cleaning.—Next to air and sunlight, the best disinfectants are good soap and water. If floors have to be brushed, the carpet should first be sprinkled with tea-leaves, and then the dust, etc., removed by firmly brushing with a stiff-bristled brush and afterwards burned. In cleaning a room, a certain amount of dusting of articles has to be done in the first place, and most of these should be collected on to a table, and all dusted articles covered with dust-sheets. It is unnecessary to say that the person should be enveloped in a large overall, and a mob cap to completely cover the hair is also desirable. The walls may

then be brushed down, the floor next dealt with, after which woodwork should be cleansed with warm water, to which a little Condy's Fluid may be added. The window-panes are then cleansed. A little methylated spirit helps to remove stains. A rather damp duster will more easily remove the dust than a completely dry one, and the duster should never be flicked or shaken about the room. Dusters should be washed daily, one duster being reserved for furniture and one for floors.

ARRANGEMENT OF ROOMS.

The Bedrooms.—The ideal bedroom contains as little furniture as possible. When ablutions can be performed in a bathroom, and when there is a dressing-room with a dressing-table, a wardrobe, etc., the bedroom furniture should consist of little more than a bed, a chair, and a table. But very few people, even if they are educated to this ideal, can put it into practical effect. We can all, however, follow the hygienic principle of dispensing with superfluous articles, and it must be left to the individual judgment as to how much can be done without in the way of pictures, ornaments, books, in the bedroom. No student of hygiene would regard the space under the bed as a storing-corner for band-boxes, or would commit the hygienic sin of placing a bookcase in front of the fireplace. Articles of clothing should never be hung about the bedroom, or on nails behind doors, but should be kept in a suitable cupboard or wardrobe, which is regularly cleaned out and ventilated.

Reception-Rooms, as we have said, should be arranged as simply as possible. If corner cupboards and glass-fronted bookcases are reserved for china and books, there is less excuse for having articles or so-called ornaments lying about. The Japanese keep their treasures in cupboards, and bring out one or two at a time, disposing of a vase in one corner, a beautiful piece of china with a spray of apple or plum blossom in another. The Japanese consider that we overcrowd our rooms, and that our art is vulgar in consequence. Another reason against over-elaboration is that the eye, and consequently the brain, are fatigued by looking at a number of beautiful objects,

and the artistic sense is more truly satisfied when the cult of simplicity is adopted.

The Bathroom.—It is difficult to maintain a fair hygienic standard in a home without a bathroom with hot and cold water. In spite of all effort, it is often impossible, because it entails a vast amount of labour, to secure daily baths for every member of the family if there is no bathroom and there is a scarcity of hot water. The closets should, if possible, be separate from the bathrooms, and, when the hot-water arrangement permits such luxuries, heated towel-rails, hot sprays, and douches are very desirable. The bathroom must be so furnished that walls and floors can be scrubbed regularly, and the drainage must, of course, be of the best type.

The Nursery should be the most hygienic room in the house. It should be of good size, with at least one large window, which must be kept open as much as possible. It is, of course, a very satisfactory arrangement if the children can have a day and night nursery, with a bathroom and lavatory to themselves. In such cases the day nursery should contain a table with rounded edges, a large cupboard for toys, several chairs, a fire-guard, and very little else. The night nursery should be furnished after the plan of the hygienic bedroom, and toilet utensils should not be used in the nursery more than is absolutely necessary. When one room has to suffice for night and day nursery, the aim should be that it contains as little furniture as possible. An enamelled bedstead with spring mattress, and small crib cots without hangings or curtains, are most suitable for the nursery. Bed-valances and window-curtains, unless the latter are washable, ought to be dispensed with. See that the fireplace is free, the chimney regularly cleaned, and that fresh air and sunshine enter the room freely. All dust must be removed daily, and the nursery should be washed over at least twice a week. The walls should be washable, and pictures and ornaments should be allowed in small amount, as every article occupies valuable air-space and harbours dust. The modern cork linoleum is the best for nursery use, with one or two small rugs, which should be shaken daily out of doors.

The Care of Bedding and Bedclothing.—It is, of course, desirable that all bedding and bedclothing should be

regularly aired. Blankets, if sheets are supplied, only require to be washed every two or three months. A light night-mat of piqué or marcella should always be supplied, the more elaborate upper bedspread being removed at night. The spring mattress should be regularly cleansed of dust, and it must be covered with a piece of material to prevent rust. The hair mattress ought to be ventilated by airing and exposing it to the sun from time to time. Careful squeezing of pillows concertina fashion will help to air and ventilate them, and the bedclothing should always be drawn back and left to air with the window open for some time each morning.

The Kitchen.—All that has been said about cleanliness and ventilation must be applied to the kitchen. Foods must be kept in well-ventilated places, free from the contamination of dust and microbes. The walls and ceilings of larders, etc., should be lime-washed once or twice a year. The kitchen walls and floors must, of course, be washable, and the sinks, slabs, etc., should be washed over every morning, and in hot weather a little Sanitas or Condy's Fluid should be added to the water. No scraps of food should ever be allowed to lie about. A meat-safe with perforated zinc sides ought to be hung beside the window, so that it is in a current of fresh air. Cheese, sugar, etc., should be kept in air-tight tins, and bread must be placed in a covered earthenware receptacle. The best disinfectants are fresh air and soap and water. At the same time, carbolic soap is very useful for scrubbing woodwork. All rubbish should be burned. The ideal housewife uses *boiling water* for cleaning jugs, cutlery, etc. Indeed, if some sort of mechanism can be procured for the home such as is used in hospital kitchens (by means of which all dirty dishes and cutlery are placed in a receptacle of boiling water and then lifted out to dry), dish-cloths can be dispensed with altogether. When dish-cloths must be used, they should be washed after each "washing-up" and boiled several times a week. When hygienic measures are disregarded in the kitchen and larder, vermin become troublesome. They must be quickly got rid of by means of traps.

FLIES.

Flies, although insects biologically, are, in the hygienic sense, vermin of the most dangerous description. Tens of thousands of people die every year in this country through the agency of flies, and the highest mortality rate is amongst the babies. Three hundred and thirty babies die every day in England and Wales, one hundred and twenty thousand a year, and many of these deaths could be prevented by a hygienic crusade against the flies. The house-fly can be distinguished from the " blow-fly " and the small flies frequently seen on window-panes and on the walls, which many people imagine to be young house-flies. The vast majority of flies in the home, however, belong to the house-fly variety. It is one of the most dangerous agents for spreading disease. It frequents manure heaps, stables, and refuse. The fly is a filthy feeder, and carries disease germs on its legs and wings right into the milk, and on to sugar, bread, butter, etc. One fly will lay over one hundred eggs at a time, and at the end of the summer be the grandparent of millions of flies. Flies are the chief cause of infant cholera, which kills two hundred babies a week in London during the fly season. Thus our efforts must be directed towards (1) the destruction of flies; (2) the prevention of propagation by removing refuse heaps, burning rubbish, and doing away with whatever encourages flies about the house; (3) the protection of food from flies. Flies may be destroyed by traps, or by placing various antiseptics (such as formaldehyde in the strength of a teaspoonful to half a pint of water) in saucers about the house. Fly-papers are more obnoxious than fly-traps of glass or fine wire gauze, which are sold for the purpose of catching flies. If these traps are baited with brown sugar moistened with beer, hundreds of flies will be caught in twenty-four hours.

But it is far more important to prevent the breeding of flies, by doing away with manure heaps and by keeping our larders and kitchens hygienic. Window-panes, etc., should be washed every morning with carbolic soap. But even if we destroy every fly in the house, a veritable army will arise in a few days, as more flies are constantly entering the open windows, eggs are always hatching, and

the only sensible thing to do is to prevent their propagation. When people realise the amount of sickness, sorrow, and suffering caused by flies, we shall have every municipality taking systemic measures for destroying eggs, larvæ, and the adult fly. The housewife must demand a high standard of hygiene in the shops, and insist on the tradesmen protecting milk, butter, etc., from flies. Perhaps the best method of protecting food in the home is to use cheap muslin which can be washed out daily. This should be placed, as has already been said, over milk-jugs, basins, etc., in which milk, stock, and butter are stored.

Disposal of Domestic Refuse.—A large amount of domestic refuse can be burned, and it should be disposed of as much as possible in this way. In most houses, one or more receptacles are necessary for keeping a certain amount of refuse until it can be removed. Ashbins, or dustbins, are made of galvanised iron, and the lids should be tight-fitting. A little dry quicklime should be sprinkled on the bottom of the bin every time it is cleaned, after thoroughly scraping the bottom. All animal and vegetable refuse (bones, bits of vegetables, fruit, skins, etc.) should be burned so that only ashes, small cinders, broken crockery, will be placed in the ashbin, thus avoiding putrefaction, which causes the production of disagreeable smells. Refuse heaps should never be allowed to accumulate. The removal of waste materials, of course, include the disposal of dirty water and the excreta of human beings, as well as of house-slops, and the water used for cooking and washing. This question was considered under the section on Drainage and Sanitation.

CHAPTER XVIII

FOOD

Why food is necessary—A healthy diet—Classification of foods—Nitrogenous foods or proteins—Carbohydrates—Fats—Water—Minerals.

The human body may be compared to a self-repairing machine. It gives out heat and energy in the form of mental and physical work. It derives its energy from food, and in a sense also from the oxygen in the atmosphere. The combustion of the food we eat produces heat, which maintains the body temperature in health at 98·4° Fahrenheit.

As a result of the energy produced by the combustion or oxidation of food material, waste matters are formed, which are excreted by the lungs, kidneys, skin, and bowels. For purposes of repair and to provide more energy, the body requires a constant supply of food at regular intervals, the actual amount necessary varying with the age and sex of the individual and the amount and quality of the work that has to be done. In cold climates, also, more food, especially more heat-producing food, is required than in hot climates. Children require more food in proportion to their body-weight than adults, because material is required for building up the body for growth.

Thus, **a healthy diet**—(1) Must contain the various "proximate principles," or ingredients, found in the body. These compounds, or proximate principles, are albuminates or proteins, fats, carbohydrates, salts, and water. (2) It must be adapted in quality and quantity to the work done. (3) It must be adapted to the climate, age, and sex of the individual. (4) It must be easily digested. (5) It must

be palatable and well cooked. (6) It should be taken at regular intervals.

The following gives the classes of different foodstuffs and their sources:

1. Nitrogenous Foods or Proteins.

Albumin	Obtained from white of egg.
Legumin	,, ,, peas, beans, and lentils.
Casein	,, ,, milk and cheese.
Myosin	,, ,, lean meat.
Globulin	,, ,, yolk of egg.
Fibrin	,, ,, meat, clotted blood, and oatmeal.
Glutin	,, ,, flour.
Gelatin	,, ,, animal matter of bones.

2. Carbohydrates.

Starch	Obtained from flour, rice, potatoes, etc.
Sugar	,, ,, honey, milk, fruit, beetroot, cane-sugar, etc.
Cellulose	,, ,, the woody parts of vegetables.

3. Fats (Hydro-Carbon).

Butter	Obtained from milk.
Animal fat	,, ,, beef, mutton, pork, etc.
Vegetable fats and oils ..	,, ,, plants, nuts, etc.

4. Minerals.

Common salt, or sodium chloride	Obtained from food, or added to it.
Phosphate of lime ..	,, ,, milk, meat, etc.
Carbonate of lime ..	,, ,, hard water.
Potash salts	,, ,, fresh vegetables.
Water	,, ,, all foods.

Acids: Malic (apples); citric (lemons); etc.

Nitrogenous Foods, proteins or albuminoids, are complex in their composition. They contain carbon, oxygen, hydrogen, nitrogen, and sulphur. They are "flesh-formers"—*i.e.*, necessary for the building up of new tissues, and they are derived, as can be seen from the above table, both from the animal and vegetable kingdoms.

The Carbohydrates, or sugars, starches, and gums, are composed of carbon, hydrogen, and oxygen, the last two elements being present in the same relative proportions as in water (H_2O).

Starch is found abundantly in the cereals—rice, tapioca, wheat, barley, oats. It is the principal constituent of potatoes. When dry, it appears as a white powder, which is seen under the microscope to be made up of grains or granules, marked with concentric rings like an oyster-shell. Its presence can very easily be detected by adding a little iodine, which forms a deep blue compound with starch. Dip a glass rod in a solution of iodine, and place it on bread or potato, or any food containing starch, and the blue coloration is quickly obtained. Starch is insoluble in cold water, but if boiled, the granules swell and burst, and cooked starch is much more digestible.

Sugar is a soluble carbohydrate, which, unlike starch, is found in animal tissues as well as in vegetable foods. The principal varieties of sugar are cane-sugar or sucrose, grape-sugar or glucose (found in fruits), milk-sugar or lactose (found in milk).

Carbohydrates are heat-forming foods, and they are a source of fat in the body. A diet rich in carbohydrates is a fattening diet.

Fats.—Fats are compounds consisting of carbon, hydrogen, and oxygen. They are derived both from the animal and vegetable kingdom. They are insoluble in water. Oil can be emulsified with water if the mixture is shaken up with a little borax powder (biborate of soda) or other alkali. Oil is a liquid fat, and all fats will become liquid if they are warmed. There are about 6 pounds of fat in the body, distributed through the different organs as adipose tissue, which is liquid during life, but becomes solid (suet) after death. Fat foods are necessary for producing heat and energy. The principal fats in the food are derived from the fat of meat, suet, lard, dripping, and butter and vegetable fats. The best-known vegetable fats are olive-oil, palm-oil, and cocoanut-oil. The fats in the food contain varying amounts of stearin, palmitin, and olein.

In cold climates, especially if much muscular work has to be done, a good deal of fat is required. Children should be given such fats as cream, butter, dripping, etc., as fat nourishes the body and promotes the digestion of other foods.

Water is contained in nearly all foods, and in some articles of diet the percentage of water is very high. Cab-

bages contain 90 per cent. of water, potatoes 75 per cent., beef 72 per cent., bread 38 per cent. Water enters into the construction of all the tissues and organs of the body, about two-thirds of the total weight of the body consisting of water. It acts as a solvent to the foods taken into the body, and is a very important factor in digestion and excretion.

Minerals.—Common salt is derived largely from food. It is added for flavouring purposes to food in cooking, and it is used as a condiment probably more than is necessary. If excess of salt is added to the food it has an injurious effect upon the tissues. At the same time, a certain amount of salt is necessary for the formation of the hydrochloric acid of the gastric juice and of various bile salts.

Carbonate of lime and phosphate of lime enter into the construction of the bones and teeth. Other mineral matters derived from food are phosphorus, oxide of iron, (necessary for the hæmoglobin of the red corpuscles), and sulphur, which is found in yolk of egg.

CHAPTER XIX

NITROGENOUS FOODS

Nitrogenous animal foods—Meat and fish—Eggs, milk, and cheese—Nitrogenous vegetable foods—Pulses and cereals.

We have said that food is required to build up the body and to supply heat and energy. Our bodies are made up of the same materials as the food we eat, and our tissues are constantly changing, being in a sense used up, to be excreted as waste, and thus having to be renewed. An adult man loses about 320 grains of nitrogen and 4,700 grains of carbon every day. We must therefore take sufficient food containing nitrogen and carbon respectively to supply this loss. Meat is rich in protein or nitrogenous food, but poor in carbon, and it is found best to use a mixed diet to get the best results. If we take certain foods rich in protein and mix them with others containing little protein, but abundant in carbohydrate and fat, the body-needs are supplied, and the digestive organs are not overtaxed.

Thus it is customary to take meat and potatoes together, protein and fat being derived from the former and carbohydrate from the latter. If fresh vegetables are added to this dish, we ensure that mineral salts and water are also present in due proportion.

The following table gives an idea of the ratio of foods required to work done:

Kind of Work.	Protein.	Fat.	Carbohydrate.	Salts.	Total.	Nitrogen.	Carbonic Acid.
	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Grs.	Grs.
Rest	2·50	1·00	12·00	0·50	16·00	175	3,150
Ordinary work	4·50	2·90	14·26	1·06	22·72	320	4,700
Hard work ..	6·00	3·50	16·00	1·50	27·00	420	5,488

Foodstuffs may be divided into nitrogenous and non-nitrogenous. Nitrogenous or protein foodstuffs, which supply nitrogen to the body, are divided into *nitrogenous animal foods* and *nitrogenous vegetable foods*.

NITROGENOUS ANIMAL FOODS.

From the flesh of animals we derive a large amount of our nitrogenous food. Flesh is in reality muscle tissue, and it consists of bundles of muscle fibres bound together by connective tissue. Flesh or meat contains a large amount of water, lean meat as much as 72 per cent. of water. Flesh foods may be divided into red meat—*i.e.*, beef, mutton, game, pork, salmon—and white meat—*i.e.*, rabbit, fowl, fish, etc.

Flesh meat used as food should be firm, of a bright colour, showing lines of fat through the lean.

Beef is more nourishing than mutton, although less easily digested; but it can be given to invalids grated or scraped.

Mutton is preferable for people who lead a sedentary life, for children, and for those who have a delicate digestion.

Lamb, or young mutton, is, bulk for bulk, less nutritious than mutton, because it contains more water; but it is easily digested and very palatable.

Veal, the flesh of the calf, is less nourishing and less easily digested than beef or mutton. It is usually served with bacon, because it is deficient in fat.

Pork takes longer to digest than beef or mutton, although the digestibility of all flesh meat depends partly upon the age of the animal from which it is derived and partly upon the cooking. In pork a great deal of the fat is inseparable from the lean meat.

Tripe is obtained from the walls of the intestines. It is easily digested, and quite palatable if properly cooked.

Game and Poultry.—Under this heading may be included the flesh of "birds"—fowl, turkey, duck, goose, and pheasant. Rabbit, hare, and venison are also generally included under game. When young and carefully cooked, they provide palatable and moderately nutritious food, but they are deficient in fat. It must therefore be added to the meal in some other form.

Liver and Sweetbread are nitrogenous animal foods, the former being the liver gland cut in slices, whilst sweetbread is the pancreas gland. The latter is easily digested if properly cooked.

Fish is a valuable article of diet, as it is more easily digested than meat and less expensive. White fish, such as cod, haddock, sole, turbot, etc., is less nourishing than fat fish—herring, mackerel, salmon, eel, sprat, etc.—as the latter contain more fat in their flesh. White fish is frequently served with butter-sauce or milk-sauce, which supplies fat, and it makes a nourishing meal if cooked with cheese, when it is almost as nourishing and less stimulating than butcher's meat.

It is very essential that fish should be fresh. The eyes and gills should be bright and the flesh firm.

Shell-Fish.—Crabs, lobsters, and mussels are used as food, but they are indigestible, and become very poisonous if they are not quite fresh. The risk of the contamination by sewage of beds of mussels or oysters adds to their danger, as typhoid, etc., has been derived from this source. Oysters are easily digested if raw, but after cooking they become tough.

Eggs form a valuable article of diet, as they contain everything that is required for the construction of the body. They are rich in protein and fat. White of egg consists of albumin dissolved in water with a small proportion of fat. The yolk is more nourishing, as it contains more albumin and a good deal of fat or oil. There is 70 per cent. of water and about 30 per cent. of solid matter in a hen's egg. The shell is formed from carbonate of lime. It is porous, and thus air containing germs can enter the egg, causing it to decompose. But if the shell is smeared with oil, lard, or butter, or any material which will close the pores, it can be kept indefinitely. The freshness of an egg can be tested by placing it in a pint of water to which 2 ounces of common salt has been added. The fresh egg will sink in this liquid, whilst the bad egg floats.

Milk is an emulsion of fat, protein (casein), carbohydrate (lactose or sugar), salts, and water. It is a perfect food in the sense that it contains these essential constituents—the

"proximate principles"—in suitable proportion, and it is the sole nourishment for the young of all mammals. While it will maintain adults in health for a considerable time, it cannot be regarded as entirely adapted to their needs. The chief source of our milk in this country is the cow, but other mammals—the goat, ass, sheep, camel, etc.—supply milk which is used as a food in different parts of the world. There is a considerable variation in the composition of human milk and the milk of the lower animals. The following table gives a comparison of human and cow's milk. It can be seen that cow's milk contains more protein and less sugar than human milk, and, therefore, when it is used for young infants it is generally diluted, and a little lactose or sugar of milk is added.

	Water.	Protein.	Fat.	Sugar.	Salts.
Cow's milk	87	4·6	3·5	4·2	0·7
Human milk	88	2·9	2·9	5·9	0·2

If milk is allowed to stand for some hours, the fat or oil or cream in the milk rises to the surface. At least 10 per cent. of milk should consist of cream. If this is skimmed from the surface, the remaining liquid is called *skim milk.* Contrary to common belief, this liquid is a useful food, as it contains albumin, sugar, salts, as well as water. If used in the dietary, the lack of fat can be made up by serving fat as butter, dripping, etc., with bread. If rennet is added to milk, a solid substance (curd) and a liquid (whey) is formed, owing to the action of the rennet ferment. If the curd—which is *casein*—is dried, salted, and pressed, it forms cheese. The whey contains the salts and lactose. If milk is boiled, the albumin coagulates, and collects as a skin on the surface. Boiling destroys all germs which may have entered the milk.

By *pasteurising*, the germs are destroyed, and the digestibility and flavour of the milk are not altered as they are in boiling. (See p. 218 for pasteurizing milk.)

Condensed Milk is milk from which a large part of the water has been removed by boiling; sugar is added, and the milk is preserved in sealed tins.

The quality of milk can be to some extent tested by means of a *lactometer*. This consists of a glass stem with a bulb at one end weighted with mercury, which registers the specific gravity of the milk, which ought to be 1029, if the specific gravity of water is reckoned at 1000.

Cheese is rich in nutritious matter. Besides the coagulated casein, it contains fat and salts; and if prepared from fresh milk, it is easily digested, and forms a nutritious food. Cheddar is a whole-milk cheese, whilst Stilton is a very rich cheese, made by adding more cream to the milk. Skim-milk cheeses, such as Dutch, American, and Parmesan, are less nutritious and less digestible. Weight for weight, cheese is as nourishing as butcher's meat, and it is much less expensive. It is only difficult of digestion if it is hard and insufficiently chewed. Toasted cheese especially requires careful mastication. Children may be given cheese if it is grated and served with potatoes, for instance. Cream cheese spread on bread-and-butter is very nourishing. The green and blue mould sometimes seen on cheese is a low form of vegetable life. On old cheese, also, maggots, which are the larvæ of the cheese-fly, and cheese-mites may be seen. These are harmless, but cannot be considered, from the hygienic point of view, a desirable addition to the cheese.

Gelatine is a food obtained from bones and cartilage after boiling; on cooling, the liquid sets as a jelly. **Isinglass** is gelatine obtained from the membrane of the float-bladder of the sturgeon. **Glue** is a gelatine derived after boiling the hoofs and horns of animals.

The following table shows approximately the times of digestion of various animal nitrogenous foods:

Food.	Hours.
Tripe and sweetbread	One.
Boiled chicken	One and a half.
Fricassée of chicken or roast fowl	Two and a half.
Liver, venison, game	Two.
Lamb and turkey	Two and a half.
Beef and mutton	Three and a half.
Roast pork	Five.
White fish	One.
Salmon, trout, and shell-fish	One and a half.
Raw eggs	One and a half.

NITROGENOUS VEGETABLE FOODS.

Certain vegetable foods, such as the cereals or grains, and the pulses, contain a large amount of nitrogen. The pulses comprise peas, beans, lentils, etc. These contain over 20 per cent. of protein and a certain amount of starch. The protein is present as legumin chiefly, and so these seeds are frequently called leguminous foods. They are utilised in vegetarian dietaries to replace meat, but they are difficult to digest, and they require careful and prolonged cooking. If combined with such foods as bacon, they form a very valuable article of diet.

The Cereals—wheat, oats, barley, rye, maize, and rice—contain a large amount of starch, whilst the nitrogenous material is present in the form of gluten. *Wheat*, after being crushed, can be separated into bran and flour. The bran, or outside shell, which contains considerable nourishment, is retained when brown bread is made, but it is separated from the flour in making white bread. Thus, brown bread is more nourishing, but it is less easily digested, than white. Bread is made by mixing flour with lukewarm water, yeast, and salt. This forms dough which, before baking, is allowed to stand for a few hours in a warm place to allow fermentation to take place. The yeast ferment acts upon the starch in the flour, converting it into grape-sugar, and then into alcohol and carbonic acid. Carbonic acid gas thus set free permeates the dough and makes it light and porous. *Oatmeal* is nutritious, and if served as porridge, which has been boiled for at least half an hour, is a very valuable article of diet. *Rye* can be used to make bread, but it is very dark and sour. This grain is liable to be attacked by a fungus called ergot of rye, which is a poison. *Maize*, or *Indian corn*, is rich in fat, and in America it is boiled and used as a vegetable. *Cornflour* is a preparation of maize, which contains only the starch. *Barley* is used in this country by brewers and distillers. *Malt* is obtained from barley after it has been allowed to germinate under suitable conditions of warmth and moisture. A ferment is produced which readily converts starch into sugar, and so malt is a useful aid to digestion. *Pearl barley* is obtained after removing the husks of the barley grains, and if these are ground to powder *patent barley* is formed. *Rice* is less nutritious, but richer in protein, than the other cereals; it contains a large amount of starch.

CHAPTER XX

NON-NITROGENOUS FOODS

Fats—Carbohydrates—Fruits and vegetables—Condiments.

It has already been stated that **fats** are derived both from the animal and vegetable kingdom. In the first group we must include butter, margarine, lard, dripping, and suet, and consider them very briefly.

Butter is obtained by churning cream or fresh milk. It is an easily digested fat, especially suitable for children and those with delicate digestions. The liquid left after churning is called butter-milk, and it is a very useful food, especially if taken with starchy material, such as potatoes. Devonshire cream is obtained by scalding the milk, which has been allowed to stand for some hours, and skimming it the following day.

Margarine.—Oleo-margarine, or butter-substitute, is obtained from nuts and milk, or from animal fat after removing the stearin by churning with milk. Margarine is a very nourishing article of diet and an excellent substitute for butter, especially for cooking purposes.

Lard is obtained from melting the fat of pig; *dripping*, from roasted meat; whilst *suet* is the solid, uncooked fat in beef or mutton.

Carbohydrates.—Many foods, such as bread, contain both protein and carbohydrate, as we have seen. Other carbohydrates not already mentioned are *sago*, obtained from the pith of sago-palms; *arrowroot*, the starch obtained from the tubers of a West Indian plant; and *tapioca*, from the roots of an American plant. These grains are wholesome foods if cooked with milk in the form of light puddings. *Potato*, the underground stem of the potato plant, contains

nearly 20 per cent. of carbohydrate, and only 2 per cent. of nitrogenous matter.

The Sugars.—*Cane-sugar* is derived from sugar-cane, which is pressed between rollers to extract the juice, the liquid afterwards being heated and evaporated to form a syrup, which is allowed to crystallise. The brown crystals are then refined to remove the colouring matter and other impurities. *Beet-sugar* is obtained from sugar-beet. *Grape-sugar*, or glucose, is found in grapes (it can be seen as little granules in raisins) and other sweet fruits, and in honey. *Lactose*, or milk-sugar, is a white, crystalline powder which can be obtained from milk.

Fruits must be included in the dietary because of the various salts and free *acids* they contain. Malic acid is found in apples, citric acid in lemons, oxalic acid in rhubarb, and tartaric acid in grapes. Fruits also contain a little nutritive matter, some of them a considerable amount of sugar; some, such as the banana, the fig, and the date, contain both starch and sugar. Fruit must neither be over-ripe nor unripe. If over-ripe, it readily decomposes, causing food-poisoning. Unripe fruit will also cause diarrhœa, unless it is cooked.

The word **Vegetable** is used to include different parts of plants which serve as food. For example, we have *green* vegetables—cabbage, cauliflower, lettuce, etc.—and these contain, besides salts and water and a little nutritive matter, cellulose, a starchy substance which is very indigestible, being the stringy part of the vegetable. It is useful, however, because of its bulk, in stimulating the peristaltic movements of the intestines, and preventing constipation. Then we have the *roots* and *tuber* vegetables, such as the potato, carrot, turnip, beetroot, artichoke, and parsnip. These contain a good deal of starch, some—beetroot and carrot, for example—also contain sugar.

Certain **Fungi,** such as mushrooms, are used as food; they contain a large amount of water (about 90 per cent.) and very little nutritious material. They are also very indigestible, and there is a certain amount of risk in adding them to the dietary. For one thing, poisonous fungi may be eaten by mistake, because of the similarity of appearance, whilst stale mushrooms develop a poisonous quality, and may produce food-poisoning.

Most of the vegetables contain a small amount of nitrogenous material and of carbohydrate, but they are chiefly valuable because of the acids and salts they contain. Vegetables must be perfectly fresh, carefully cooked, and palatably served. Certain vegetables, such as lettuce, radish, cress, etc., are served uncooked as salads. They are rather indigestible, and they should be carefully washed and cut into very small pieces. Marrows, cucumbers, and pumpkins, also tomatoes, are fruits which are used as vegetables.

Condiments.—Certain substances are included in the dietary, although not strictly speaking foods, because of their effect in stimulating appetite and assisting digestion. These are called condiments, and the most important of them are salt (already considered), various pungent substances such as mustard and pepper, certain *acids* such as vinegar and lemon-juice, and a group of *aromatics*—nutmeg, cinnamon, cloves, allspice, thyme, parsley, etc.

Mustard is obtained from the seeds of the mustard plants.

Pepper is a ground berry or peppercorn of a climbing plant, grown in tropical countries. When the husks of the berry are removed before grinding, white pepper is obtained. Cayenne pepper is derived from the crushed pods of the plant called chillies. Other pungent substances are *ginger*, made from the dried root of the ginger plant, and *horse-radish*, the grated root of the horse-radish plant.

Vinegar is dilute acetic acid, obtained from malt or by the oxidation of alcohol by fermentation, or by the distillation of wood. Vinegar is much used as a preservative in the pickling of vegetables and of flesh food also. If taken in very small quantities, it cannot be said to harm digestion, but it exerts an injurious effect upon the mucous membrane if taken in excess. Other vegetable acids, especially *lemon* and *lime juice*, have valuable antiscorbutic properties—that is, they prevent scurvy, a disease of the blood, which, in a mild form, sometimes affects infants fed upon patent foods, with an insufficient allowance of fresh milk. The various aromatics or spices are derived from fruit, roots, leaves, etc., of different plants. *Nutmeg*, *caraway* and *coriander*, are seeds; *cloves* are dried flower-buds of a West

Indian tree; *allspice* is a berry; *vanilla* is extracted from the pods of a plant belonging to the orchid family; *cinnamon* is the dried bark of the cinnamon laurel, which grows in Ceylon, Borneo, etc.

The leaves of certain plants—for example, *parsley, mint, thyme, sage*—which contain a volatile oil, are used as condiments; whilst among vegetables, the *onion* family is used both as a condiment and as a food.

CHAPTER XXI

BEVERAGES

Aerated waters—Tea, coffee, cocoa—Alcoholic beverages—Wine—Beer—Spirits—Physiological effects of alcohol.

BEVERAGES, for purposes of description, are generally divided into non-alcoholic beverages, such as tea and coffee, and alcoholic, or intoxicating beverages, as spirits, wines, and ales. The best beverage, because it is the natural drink of all animals, is water.

Aerated Waters are charged with carbonic acid, and they contain alkaline salts in solution. At Vichy, Spa, and other health resorts, natural aerated waters are found, and large quantities of soda-water, potass-water, etc., are produced artificially.

Tea, Coffee, Cocoa.—These three substances resemble each other in that each possesses an active, stimulating material, or *active principle*—theine, caffeine, and theobromine, respectively. The action of all three is to quicken the heart and pulse and to stimulate the nervous system, thus diminishing the sense of fatigue and the inclination to sleep. In excess, these active principles produce over-excitation of the heart and respiratory system, and of the nervous and muscular system, producing palpitation, restlessness, tremor of the muscles, and excitement. These three beverages also contain an aromatic volatile oil, which gives the distinctive odour and flavour, and which is said to produce the headache so frequently complained of by tea-tasters and employés who are constantly inhaling the oil when it is being packed for market. Tea further contains an astringent called *tannin*, which develops after long infusion, whilst the same astringent is found to a less amount in coffee, and is called caffeo-tannic

acid. Cocoa, which contains little, if any, tannin, is rich in fat, cocoa-butter being present to the extent of 50 per cent.

Tea consists of the dried leaves of the tea-plant grown all over the East. The leaves are spread on flat, bamboo trees to dry for a few hours, then roasted over a wood fire, and afterwards rolled. Black teas are prepared by allowing the leaves to ferment in heaps for some hours, and then roasting them over charcoal fires. As a food, tea is of very little value. It is made by infusing with boiling water, which extracts chiefly theine, tannin, and volatile oil, and sugar and milk are added to the infusion when served. Tea must be regarded not as a food, but as a stimulating beverage. It should not be drunk too hot nor too strong; if used in excess it causes indigestion. It must be very carefully prepared. The teapot should be heated with boiling water, which is emptied out again; the tea-leaves are then placed in the pot, and freshly boiling water is poured over them. The infusion should stand for five minutes, and then the liquid is poured into another teapot, which has been previously warmed. Hard water is unsuitable for making tea, but when soft water cannot be procured, it is best to boil the hard water for some time, and then to add a pinch of bicarbonate of soda.

Coffee is the berry or seed of a plant grown in Ceylon, the West Indies, and Arabia. The seeds are roasted and then ground to a fine powder. Coffee is, like tea, a stimulant, and it is a valuable beverage if taken in moderation, but injurious to the digestion and the nervous system in excess. Coffee is sometimes mixed with chicory, which is obtained from the root of a plant cultivated in the Netherlands, which is known as the Wild Endive in England. The addition of chicory gives a deeper colour and a slightly different flavour to the infusion. Coffee is prepared in the same way as tea, but a larger quantity should be used—a tablespoonful to each cup. The infusion should stand for ten or fifteen minutes.

Cocoa is the seed of a West Indian plant. The seeds are collected and allowed to undergo a kind of fermentation, roasted, ground, and dried. *Chocolate* is prepared from the cocoa kernels, or nibs, by mixing with sugar and flavouring substances. Cocoa is a valuable foodstuff because of the large amount of fat it contains, whilst it has certain

stimulating properties. Cocoa is served, not as an infusion, but as a mixture with boiling water or boiling milk, which is improved in value if boiled for a minute or two, because it contains a considerable amount of starch.

Alcoholic Beverages.—All alcoholic beverages contain, besides alcohol, a certain amount of sugar, salts, acids, and aromatic volatile oils. The alcohol is derived by fermentation. A solution of sugar, such as grape-juice, is exposed to the air at a certain temperature; the sugar is decomposed, or changed chemically, into carbonic acid gas and alcohol. This process is known as fermentation, and it is caused by a microscopic fungus. Alcohol is a colourless liquid, with a characteristic odour and taste. It is inflammable and volatile—that is, it evaporates if exposed to the air. It contains a large quantity of water, and to obtain pure or absolute alcohol it must be distilled with quicklime or potassium carbonate, which unites with the water. The percentage of alcohol in different intoxicating beverages varies considerably.

Wines are prepared by fermenting the juice of the grape. If the juice and skins ferment together, a red wine is obtained; if the juice is drawn off before fermentation begins, a white wine is produced. Sparkling wines contain free carbonic acid gas, which develops in wine if it is bottled before fermentation has ceased. Wines have very little nourishing property, but they are stimulating owing to the alcohol they contain. Amongst wines we must include the less alcoholic British wines, such as gooseberry, orange, and currant wine; cider and perry also are produced by the fermentation of apples and pears. These are stimulating beverages; they contain less alcohol than grape wines.

Amount of Alcohol in Various Alcoholic Beverages.

Brandy	55 per cent.
Whisky	54 ,,
Rum	53 ,,
Gin	51 ,,
Sherry	22 ,,
Port	21 ,,
Madeira	19 ,,
Champagne	11 ,,
Claret	8 ,,
Burton	5 to 4 ,,
Porter	
Lager beer	

Beer is obtained by germinating barley, which produces a ferment, diastase, capable of converting starch into sugar. The barley is soaked in a cistern for some hours, and then spread in warm rooms to germinate. When it has sufficiently sprouted, the barley is dried gently, after which it is known as malted barley, and the brewer places this malt in a mash-tun with warm water, to facilitate the further transformation of starch into grape sugar, after which it is boiled, and various bitters, such as hops, are added to it. It is then cooled and treated with yeast and allowed to ferment, so that the sugar is decomposed into alcohol and carbonic acid; the yeast is skimmed off, and the beer stored in casks. There are many varieties of beer. Mild ale or pale ale is made from the finest malt and hops; porter and stout are coloured with roasted malt. Lager and bock beer are richer in alcohol and malt than the lighter beers. If beers are bottled while fermentation is going on, they retain free carbonic acid, and are thus sparkling.

Spirits are made by the distillation of a fermented liquor. Brandy is distilled from wine; whisky from malted grain; gin is distilled from a mixture of malt and barley, subsequently flavoured with aromatic substances; and rum is obtained by distillation from fermented skimmings of sugar-boilers or sugar-barrels (molasses).

The Physiological Effects of Alcohol.—The effects of alcohol differ according to the amount taken and the condition and health of the individual. In small doses, it is a stimulant to the lining membrane of the stomach, thus promoting digestion; it is absorbed into the circulation, increasing the heart's action and stimulating the nervous system. But if it is taken frequently, even in small doses, but more especially if taken in any large quantity, it depresses and paralyses the nervous system. It delays digestion, causing catarrh of the digestive organs, and degeneration of the liver and kidneys. Alcohol should never be taken fasting. It should be regarded as a poison by young people, because of the very real danger that exists of a definite liking being established for alcohol, and the formation of the habit of alcoholism. Alcohol is a valuable drug if administered by a medical man, but it is significant that its use is much less prevalent than was the case ten or twenty

years ago. It has been found that alcohol lowers the resistance of the body to cold, because it causes the surface bloodvessels to dilate, giving a false sense of heat, and thus heat is rapidly lost through the skin. The healthy will work and endure fatigue better without alcohol. The sick and feeble and elderly should have it administered under the advice of a doctor. The excessive use of alcohol lowers the vitality, reduces the resisting power to disease, lessens the will and reasoning faculties, and the victim to alcoholism generally suffers from degeneration of moral principles.

CHAPTER XXII

DIETETICS

Appetite—Good digestion—Mastication—Amount of food—Moderation—Excess of food *versus* under-nourishment—Children's diet—The daily menu—Exercise and rest—Invalid diet.

After studying the physiology of digestion, and the properties of the various food materials used by man, we are enabled to form a fair idea of common-sense dietetics. In good health appetite exists; meals are digested without pain or discomfort, and without any sense of lassitude after food. *Hunger* is Nature's method of telling us that the body requires more fuel to make up for waste, to supply new energy, and new material for growth. *Appetite* may be defined as a desire for food, and depends partly upon hunger and partly upon the mental condition of the individual. The secretion of saliva, gastric and pancreatic juices, commences before the food is taken into the mouth, being initiated by the thought or anticipation of the meal. The secretion is subsequently maintained by the sight, smell, and later on by the taste of the food; finally, after the food has reached the stomach, the secretion is continued by the chemical action of the substances formed by the saliva (especially dextrin), as well as by substances in the food itself—*e.g.*, extract of meat. The value of the appetite factor in secretion is very great, as it has been shown that one can digest four or five times as much food with appetite as without it. Appetite can be artificially stimulated to some extent by condiments. A person who lives a healthy life, who works, and who is careful to obtain outdoor exercise, can generally depend upon a natural and wholesome appetite. *Thirst* may be an indication that the tissues require water, but it may also be

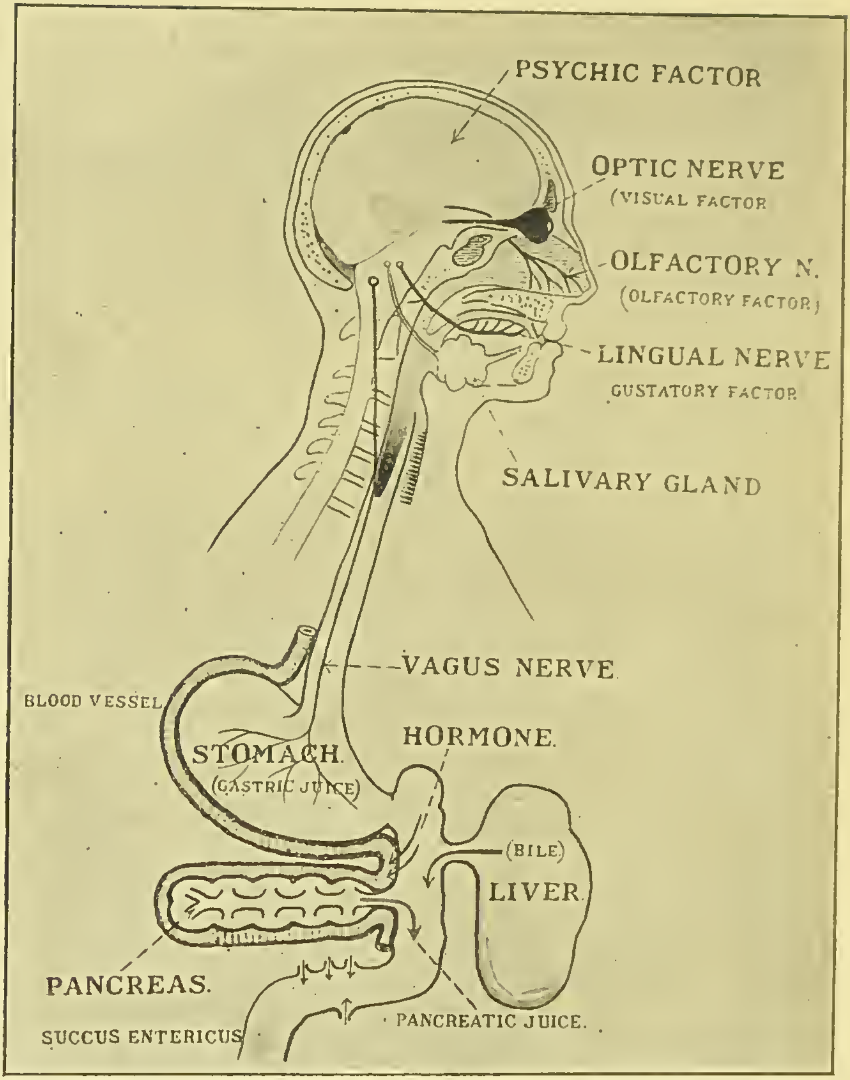


Diagram to illustrate Various Factors in Appetite and Digestion, viz., Psychic (Thought of Food); Visual (Sight); Olfactory (Smell); Gustatory (Taste); Chemical (Secretion in Mouth, Stomach and Intestines).

(Lent by Dr. Strickland Goodall.)

produced by an erythema or slight inflammation of the lining membrane of the mouth and pharynx, in which case it is relieved by sipping and holding water in the mouth some

time before swallowing. Careful *mastication* of food is not only essential to *good digestion*, but it brings out the flavour of the food, which becomes more satisfying. By careful chewing, also, less food is necessary, because thorough mastication provides that more nourishment is obtained from any given quantity.

The *amount of food* taken must, as we have seen, be suited to the varying conditions of age, work, and general environment. A mixed diet is found in practice to be the most advantageous. Whilst some people may eat excess of meat, which leads to the clogging of the system with nitrogenous matter and the formation of uric acid, causing gout, rheumatism, etc., vegetarian diet has also disadvantages. To get the amount of proteid necessary for health, such large quantities of vegetarian material have to be consumed, that the digestive organs are overtaxed. If butcher's meat is taken once a day, and if eggs, milk, and cheese are liberally included in the dietary, the health-needs of the individual are best ensured.

Moderation.—To maintain health equilibrium, excess of food and an insufficient dietary must both be guarded against. The consumption of *too much food* will be followed by digestive derangement, because the organs of digestion are overtaxed; the result is that poisons or "toxins" are produced in the alimentary canal and absorbed into the blood, causing depression of the nervous system, lassitude, headache, etc. All the tissues of the body are adversely affected by excess of food. Poisons are retained which should be eliminated; thus various diseases are apt to develop, and the individual is, as a whole, less efficient. *Too little food*, on the other hand, means that the body is under-nourished; the blood is defective in quality, there is anæmia, and development is arrested. Children especially should have sufficient nourishing food; they require a relatively larger amount of protein to supply material for growth. A child of six years, for instance, requires half as much protein and half as much fat as an adult man. The fat should be given in its most palatable form, as butter and cream, whilst a child's diet must be rich in milk and eggs, because these contain considerable mineral matter, which is necessary for the development of the bones and teeth.

The Daily Menu.—Meals must be served regularly, and three meals a day are found, in practice, to be best for the digestion and the health generally. A four or five hours' interval between meals ensures the complete digestion of food, and promotes appetite. Eating between meals is fatal to good health, and those who cannot dispense with afternoon tea, should limit themselves to one cup of weak tea without any solid food at all. A *breakfast* of well-boiled porridge, egg, or fish or bacon, with toast and marmalade, a cup of coffee and milk, varied with cocoa or tea, will supply all the proximate principles of diet in suitable proportions. The porridge may sometimes be replaced by fruit, especially stewed fruit. The *luncheon,* if it forms the chief meal of the day, should consist of two or three courses, soup or fish, meat with vegetables, sweets or cheese. Those who are engaged in work in the afternoon, however, generally prefer to take a light meal of milk, bread and butter, and eggs, or cheese or fish, with perhaps a little fruit, and reserve their chief meal until the evening. If, however, a heavy luncheon has been taken, the *dinner or supper* should be light. It is impossible to give definite tables as to quantities and articles of diet, because individuals, even of the same sex and age, vary considerably in their diet needs. It may, however, be taken as a guide that to supply an adult man with 125 grammes of protein, 500 grammes of carbohydrate, and 50 grammes of fat, his daily allowance should be about ½ pound of flesh meat, 4 ounces of fat, 1 pound of vegetables, including potatoes, 1 pound of bread, two eggs, 1 ounce of cheese, a glass of milk, two cups of tea, coffee, or cocoa, and water. A man engaged in hard labour would, however, require a more liberal allowance of food; whilst most people would prefer to reduce the amount of meat in this dietary, and to add more vegetable nitrogenous food, such as would be supplied by lentils, beans, or peas. Late, heavy meals are always undesirable. The last meal should be taken not later than two or two and a half hours before bedtime. If a heavy meal is eaten late at night, digestion is still going on during sleep, and restlessness, headache, and sleeplessness are apt to develop.

Exercise and Rest.—If outdoor exercise, games, or manual work out of doors are freely indulged in, more food can be taken than if the life is sedentary. Moderate exercise

helps digestion and gets rid of waste products from the body, because it makes the excretory organs, especially the lungs and skin, more active. Excessive exercise, however, induces fatigue of the organs as well as of the muscles and nervous system, and that is why an attack of indigestion may follow the eating of a heavy meal when fatigued.

Invalid Diet.—During an illness and in convalescence the digestive organs are incapable of dealing with the same amount of food as in health; it is thus customary to give small meals of easily digested food fairly frequently. If there is a rise of temperature or *fever*, liquid foods, consisting chiefly of milk, whipped egg, and soups, are supplied every two or two and a half hours. In fever, also, water, barley-water, lemon-water, and soda-water are given to relieve thirst, and to promote the excretion of poisons from the body. In such diseases as rheumatism, flesh foods and beer are generally forbidden. In cases of enfeebled digestion, all greasy, rich foods, meat that has been twice cooked, and vegetables, pickles, pastry, and similar articles of diet, should be avoided. Where there is a tendency to constipation, stewed fruit, oatmeal porridge, brown bread, and vegetables are useful. (Invalid diet is also considered in Chapter XXIV. and in the Home Nursing section.)

CHAPTER XXIII

COOKING

Why food is cooked—Methods of cooking—Roasting, broiling, baking, frying, boiling, stewing, hashing, soups—Cooking fish and vegetables.

Food is cooked in order that it may be more palatable and attractive, and because cooking breaks up the solid food, making it more easily masticated.

Secondly, because when food is cooked it is altered chemically to some extent. Starchy foods are broken up, and a certain amount of the starch is converted into dextrin. Warm food is more digestible than cold, uncooked food, and cooking also destroys any germs or parasites which may be present in meat, vegetables, milk, etc. Another advantage of cooking is that it stops putrefaction or decomposition, and food "keeps" for a longer time after cooking. Food must be prepared for cooking; it must be cleansed and perhaps cut or divided, so that cooking may be more easily facilitated. In some cases the food (haricot beans, salt beef, etc.) is laid aside for a time after preparation to soak in water, so that it may be softened and more easily cooked. Food is cooked in various ways; there are six methods, for instance, of cooking animal food—roasting, baking, broiling, frying, boiling, stewing. If hashing and soup-making are included, we have eight methods of cooking "meat."

Roasting.—By this method a joint is first exposed to great heat by placing it near a clear fire in order to coagulate the albumin on the outside of the joint to retain the juices of the meat. After five or ten minutes the joint is moved to about 12 inches from the fire to cook slowly. It should be kept constantly in motion, and fre-

quently " basted " with fat. About a quarter of an hour should be allowed for every pound of meat, and a quarter of an hour over. Roasting coagulates albumin and myosin, and changes the connective tissue of the meat into gelatine.

Broiling, or **grilling,** is a process analogous to roasting, the meat being placed on a hot gridiron over a clear fire and turned every two minutes. An envelope of coagulated albumin is formed over the meat, as in roasting, and great care must be exercised not to pierce this crust by a fork in turning. Steak-tongs or a fish blade should be used instead.

Baking.—This method of cooking corresponds to roasting, but is done in a hot oven. The joint should be placed on a wire table in the baking-dish to prevent the meat being soaked with grease. The modern oven is well ventilated, so that there is no risk of the meat reabsorbing the vapours it gives off.

Frying is the cooking of food in hot fat. It makes meat very indigestible, because the fibres are rendered tough, and fried fat also is more difficult of digestion. This form of cooking is more suitable for fish, but even fish is more digestible if boiled.

Boiling a joint is to plunge it into boiling water for five minutes to coagulate the albumin on the outside, in order to retain the meat juices. The water should then be kept below boiling-point at a temperature of about 170° F. If the water is allowed to boil all the time, the meat becomes hard and indigestible. The water in which meat has been boiled can be used as stock for making soup. If the meat is put into warm water, more of the juices escape and a rich broth can be made, but the meat is less nutritious and less digestible. The time allowed for cooking is the same as for roasting. To boil fish the water should be just below boiling-point, and it should be kept, not boiling, but simmering. Soft water should, as much as possible, be used for boiling, but when hard water only is available, a pinch of carbonate of soda should be added, and the water boiled up first, before being used for cooking.

Stewing is the most economical method of cooking, because there is no waste. The meat should be cut into small pieces and placed in the stew-pan, covered with cold water

or stock. It must not boil. If a little vinegar is added, it helps to soften the meat, and vegetables are generally also utilised for making the stew more attractive and more nourishing. A double saucepan may be used, the stew, with water or stock, being placed in the upper pan, whilst the lower saucepan is filled with water, which is kept boiling. By this means the stew remains just below boiling-point, and there is no risk of it becoming tough. In stewing there is no loss of weight.

Hashing is simply the stewing of meat that has been previously cooked. Twice-cooked meat is never so digestible, but careful cooking can convert a hash into a very nourishing and palatable dish.

Meat loses about 25 to 30 per cent. of its weight if baked or roasted, but the loss is mainly water.

Soups.—Soup is made either from fresh meat or from *stock* (the liquor in which meat has been boiled with the addition of vegetables and seasonings). A large pot should invariably be kept for stock-making purposes, as various scraps of food—bones, pieces of bacon, vegetables, sauces, or bits of meat left over from previous meals—can be used up in an economical way in making stock. It should be frequently skimmed, and it must be boiled for some hours, then passed through a sieve, and, if necessary, clarified. To clarify stock, after cooking, strain the stock, put into a pan, and add to it the white and shell of an egg with a little cold water, stir continually with a whisk until it reaches boiling-point, then move the pan to the side of the stove, and keep it just below boiling-point for twenty-five to thirty minutes; then strain through a wet cloth into a clean pan.

To thicken stock, use flour or cornflour or fine sago, mixed to a cream with cold water, 1 to 2 pints to 1 quart stock.

Soup may be made from fresh meat instead of from stock. The meat should be cut into small pieces and placed in cold water to soak, then heated gradually to about 170° F., at which temperature it should be maintained for two or three hours, after which it should be boiled for an hour, when all the nourishment will have been extracted from the meat.

Fish is boiled in a fish-kettle, using enough cold water to cover the fish. The water should be boiled as quickly as

possible, and the scum removed directly the water reaches boiling-point. About 4 to 6 ounces of salt should be added to every gallon of water. Fish may also be cooked by frying, when it is less digestible; or it may be baked and served with butter. Steaming is an excellent method of cooking fish.

Vegetables. Green vegetables may be cooked in a steamer, or boiled. They should be carefully trimmed and washed, and soft water should be used, or water to which carbonate of soda has been added.

Potatoes should be placed in boiling water or steamed, and they are more nourishing if cooked with their skins on, because there is a layer of nitrogenous material beneath the skin which is lost if the potatoes are peeled.

CHAPTER XXIV

INVALID COOKERY

Gruel—Custard—Curds and whey—Egg-flip—Blancmange—Beef-tea—Broth—Barley-water—Jellies.

The preparation of sick-room dishes in detail should be obtained from a cookery-book; but certain articles of diet frequently used in the sick-room must be briefly mentioned. Milk is the best of all foods for the sick-room, and it can be served hot or cold, or utilised in the preparation of various custards and milk puddings, whilst it can be taken also as milk jelly and as junket. Milk gruel is a useful article of diet in sickness.

Gruel.—Two tablespoonfuls of fine oatmeal are mixed thoroughly with a teacupful of water, allowed to settle, and the fluid poured off. A pint of milk is added to this, and the mixture placed in a saucepan and boiled gently for about fifteen minutes, stirring all the time. The gruel can then be flavoured with sugar or salt, and served with thin bread-and-butter. It makes a very appetising and nourishing food for invalids.

Boiled Custard.—Half a pint of milk is warmed in a saucepan, and a teaspoonful of sugar and a grating of nutmeg are added. A well-beaten egg is stirred into the milk, and the mixture is put into a little jug, which is placed in a saucepan of boiling water and stirred until it thickens, which takes, perhaps, about ten or fifteen minutes; the custard is then ready.

Baked Custard.—Put two beaten eggs in a pie-dish, and add ½ pint of cold milk, a little sugar, and grated nutmeg. Bake in a slow oven.

Curds and Whey.—Stir a teaspoonful of fluid rennet into ½ pint of new warm milk, adding a little sugar to sweeten.

Let it stand in a warm place until set. This may be served with a few spoonfuls of cream on top.

Egg-Flip.—Beat the yolk of an egg with two tablespoonfuls of milk; add a tablespoonful of brandy or half a wineglassful of port.

Invalids' Blancmange.—Dissolve 1 ounce of isinglass in a pint of milk and strain through muslin; add an ounce of castor sugar, and warm gently until nearly boiling in a saucepan. Pour into a wet mould to set.

Beef-Tea.—Cut into small pieces ½ pound of the top side of a round of beef, after removing the skin and fat. Place in a jar with a tablespoonful of cold water and a little salt. It may be left to soak for an hour if time allows, or the jar may be at once placed in a saucepan of cold water, which should be immediately brought to the boil.

Raw Beef Essence.—Chop ½ pound of beef, add a teacupful of water and a little salt. Stand the mixture for three hours in a cool, well-ventilated place. Strain and serve in a coloured wineglass to disguise the red colour.

Broth is made from mutton, fowl, or chicken. Half a pint of water is used to a pound of meat. It should be put on the stove cold and cooked slowly, so as to get all the nourishment out of the flesh-fibre. A little boiled sago, rice, or barley can be added as desired. Broth must be made fresh each time.

Jellies are less popular for invalid consumption of recent years, partly because jelly is known to be an excellent medium for the propagation or culture of germs, and partly because of the tendency to overrate "jelly" as nourishment for the sick.

Calf's-foot jelly is made by prolonged simmering of calf's feet with various vegetables and flavouring agents, with or without sherry. The receipes for different jellies can be obtained from any cookery-book.

See Chapter XXXIII. for Feeding Invalids.

CHAPTER XXV

COOKING APPLIANCES

Various kitchen utensils—The open fire—Ranges—Stoves.

In order that food may be properly cooked and stored in the kitchen certain apparatus is essential; saucepans, for example, of iron, enamel, tin, or copper lined with tin, are used for boiling and stewing. Enamel and iron saucepans are the most satisfactory, as there is some risk that those lined with tin contain lead. All kitchen utensils must be kept scrupulously clean by scalding after use. The food should never be left in them from one meal to another.

Frying-Pans should be fitted with a wire basket for using when fish is cooked.

Dripping-Pans are used for placing under a joint to collect the melted fat.

The **gridiron** can be used either for fish or for chops and steaks. A **double saucepan** will be found useful for making porridge or stews, whilst **steamers,** which fit into saucepans, are frequently used for the cooking of vegetables. **Baking-dishes** or pie-dishes may be made of earthenware or of enamel, whilst **hot-pots** are much used for cooking rabbit, mutton, or steak with vegetables; they are made of earthenware, and supplied with a lid, which fits tightly. A large iron saucepan should be reserved as a **stock-pot,** so that odd pieces of bone, meat, bacon, and vegetables, etc., may be boiled down to make stock for soup and sauces.

Cooking Ranges and Stoves.—The open fire-grate and the closed range, or kitchener, are used a good deal in this country for cooking purposes. The *open fire,* however, consumes a large quantity of coal, and is wasteful in the sense that eight to nine-tenths of the heat passes up the chimney.

Another disadvantage is that dust very readily gains access to the food.

The *closed range* is cleaner and more economical. It is nowadays fitted with a ventilated oven, and it is also generally supplied with a boiler, so that a continual supply of hot water can be obtained. Where any considerable amount of cooking has to be done, there is no question of the advantage of the closed range over the open fire. The range, of course, must be cleaned every morning and the flues swept out, in order to ensure a hot oven and hot water in the boiler.

Stoves should be fitted into an ordinary recess of the fireplace, so that all products of combustion are carried away by the chimney. If placed in the open room, they should be fitted with a special chimney to carry off the impure gases and the smell of cooking. Cooking-stoves may be filled with coal, coke, charcoal, or anthracite, whilst gas-stoves are being more and more used in towns for cooking purposes. The modern stoves are supplied with ovens and hot plates, and in some cases with movable boilers. The best varieties are made of enamelled steel, which are easily kept clean. An important matter with all stoves is that they should be cleaned thoroughly every day. With a stove-oven an even temperature is maintained, while a kitchen-range fire may be too hot or too cold, producing a variation of temperature in the oven.

Preservation and Storage of Food.—Certain foods, such as meat, fowl, fish, etc., deteriorate or decompose if kept for any time exposed to the air, owing to the action of various germs or bacilli. Thus the housewife, who has limited means of preserving food, buys such articles in small quantities, because of the danger of eating anything that has to the slightest extent become decomposed. The custom of using up stock that has become sour, meat that is slightly tainted, rabbit that has begun to smell, is excessively dangerous.

The question of preserving food in hot weather is an important one. Food will keep better in a well-ventilated larder which is kept scrupulously clean. It must be carefully protected from flies. Plain muslin, washed daily in tepid water and then in cold water, wrung tightly and then spread over basins of soup or milk or other food, is extremely

useful in the larder. Where dry food, such as grain, meal, etc., has to be stored, it should be kept in clean enamel receptacles. Cheese will keep in an airtight biscuit-box, whilst bread must always be stored in a covered receptacle. Special attention should be paid to the question of a pure milk-supply from a reliable dairy or farm, and to keeping the milk fresh and uncontaminated by dust or flies.

Food is preserved on a large scale for the market by refrigeration, by drying, by the application of heat and subsequent storing in airtight cases, when the food is said to be tinned or canned. Preservatives, such as boracic acid, salicylic acid, etc., are to be condemned.

Parasitic Diseases may be contracted by eating imperfectly cooked flesh meat. "Measly pork" is the flesh of pig which contains embryos of the *tapeworm* (*Tænia solium*). In the stomach, the embryo is liberated from its cystic shell by the action of the gastric juice, and it attaches itself to the mucous membrane of the intestine, and proceeds to grow by forming buds or segments behind its head. The mature tapeworm has a flattened, tape-like body, consisting of segments jointed together. Each segment contains eggs, and as they pass in the excreta from the intestine, the envelope decays, and the ova, or eggs, are scattered. Some are eaten by pigs, and in the stomach of the pig develop into embryos, which, by means of six boring hooks, pass through the body to the muscles, giving them a measly, speckled appearance.

The *beef tapeworm* (*Tænia medio-canellata*) is similar to the pork tapeworm, but the head has four suckers and no hooklets. When "measly beef" is eaten the embryos are liberated, and develop in the intestine into tapeworms 20 or 30 feet in length.

Tænia echinococcus is found in the dog, but the embryos occasionally find their way into the body of man and develop cysts (hydatid cysts) in the liver, brain, and other organs. It is prevalent in Iceland, where dogs are much used for work.

Trichina spiralis is a small worm, with boring instruments, which may be swallowed in eating imperfectly cooked pork and sausages, but it is rarely found in this country.

Roundworms may develop in the intestines as a result of the eggs of the worm being swallowed in imperfectly washed, uncooked vegetables. *Threadworms* are small white worms found in the bowel of badly nourished and improperly fed children. They are treated by attention to the general health and injections of salt and water with suitable medicines.

(For External Parasites, see p. 80.)

CHAPTER XXVI

CLOTHING

Objects of clothing—Materials—Characteristics of clothing—Wool, silk, cotton, linen, mesh—Colour.

THE main objects of clothing are—(1) To maintain and conserve the heat of the body; (2) to protect the body from excessive heat, cold, wet, and injury; and (3) to provide ornament or adornment.

It may be said generally that we wear clothing mainly to keep the body at a uniform temperature. Suitable clothing prevents undue loss of heat from the body, and under other climatic conditions it protects the skin and underlying tissues from the burning rays of the sun. Thus one layer of clothing at least must be made of such material as will not permit of the easy passage of heat through its meshes—*i.e.*, it must be a slow conductor of heat. Wool answers many of the requirements of a hygienic material. It has no affinity for damp, such as vegetable fibres (cotton and linen) are known to have. Its fibres do not run parallel or straight, but are irregular in outline or wavy, so that wool always contains a good deal of air between the interstices; this air is a bad conductor, and at the same time it allows moisture to pass slowly from the body by evaporation. It may be said that wool is stimulating to the skin, because it has a "sharp, serrated edge," as Mr. Grant Ramsay, of the Institute of Hygiene has emphasised, which stimulates the superficial capillaries, and consequently the circulation. This quality makes wool act as an irritant upon certain people, whose circulations are very active; but most people, especially children and those of a rheumaticy tendency, will find wool the best material to wear next the skin. It may be taken as a hygienic axiom that

light, loosely woven, woollen material should be worn next to the skin in this climate; at the same time it is possible to purchase cotton and linen that is "porous." Silk is a valuable material for clothing for those who find wool irritating to the skin. Cotton and linen are suitable for summer, but it is best not to wear them next to the skin, as they absorb moisture, and consequently they may cause chill, as they interfere with the evaporation of perspiration, and moisture remains in contact with the skin. Both are good conductors of heat, especially linen. By a *good* conductor is meant a substance through which heat passes rapidly; a non-conductor or a bad conductor, on the other hand, is a material through which heat passes or spreads slowly to other parts. The body loses heat chiefly by the skin. Probably 90 per cent. of the total loss is by conduction and radiation (the body radiates heat, as a fire radiates heat in a room) and evaporation. When the body is heated by exercise, for instance, the surface of the skin is covered with moisture, which evaporates, carrying with it heat from the body. Evaporation is more marked in hot weather. In cold weather evaporation is not active, but heat is lost by conduction and by radiation. A certain amount of heat is also lost by respiration and through the medium of the excreta of the body.

CHARACTERISTICS OF CLOTHING.

(1) From what has been said about the qualities of the different materials it will be readily understood that clothing ought to be *porous*, to allow of evaporation and to prevent undue loss of heat, by maintaining a layer of air in the interstices of the garment. (2) Clothing should be *light*. Heavy clothing does not preserve heat so well as light clothing made of a non-conducting material. (3) It should be *loose*. Loosely fitting clothes are warmer, because they allow layers of air (a bad conductor) to lie between the various garments. Tight clothing is dangerous, in that it exerts pressure on the vital organs and on the bloodvessels; tight garters will produce varicose veins, for instance. A tightly fitting hat, by pressing upon the bloodvessels of the scalp, will cause baldness, whilst tight neckbands are responsible for many ills, from headaches to neuralgia. Tight corsets will even produce serious

deformity of the ribs. Boots and shoes which are so tight as to exert pressure cause deformities of the toes, bunions, and corns. (4) Garments should be so made that there is no pressure in the waist region, and that the *weight* is borne mainly by the shoulders. (5) It should be *evenly distributed* over the body. To leave the chest bare, or cover it with a thin, transparent blouse, whilst the lower part of the body is heavily clothed, and the feet and legs again are covered with thin stockings and thin-sooled shoes, is unhygienic, and, indeed, dangerous to health. (6) Garments should be few in number. Overclothing must be avoided; it simply *provides more weight* to be carried about, which uses up body energy and causes fatigue, and in exercise one gets overheated and perspires, so that there is risk of chill.

MATERIALS AND TEXTURES.

We have said that the chief materials used for clothing are wool, silk, cotton, and linen.

Wool consists of soft, elastic fibres several inches in length, which, under the microscope, are seen to be irregular, in

A. B. C. D.

MICROSCOPICAL APPEARANCE OF FIBRES OF—
A, COTTON; B, SILK; C, LINEN; D, WOOL.
(From "Hygiene and Public Health," Newsholme.)

that they are covered with small scales which overlap. The chief woollen materials are flannel, cashmere, mohair, alpaca. Wool should be worn next to the skin, because

it absorbs perspiration without becoming damp, and one is less apt to contract chill after exercise if woollen clothing is worn. Woollen garments should always be bought of a rather large size, because wool shrinks; and although unshrinkable wool can be purchased, it is less advantageous, as it has been treated with acids, which remove the serrated edge, which it is desirable to retain because of its stimulating effect upon the circulation. To avoid shrinking woollen material, it should be washed in lukewarm water in which plain soap has been dissolved, then rinsed in clean water, folded, and passed between the rollers of a mangle to squeeze out excess of water, and quickly dried.

Silk.—Under the microscope, silk is seen to be composed of smooth, round fibres. The material is obtained from the silk thread spun by the silkworm. It can be made into satin, taffeta, plush, velvet, etc. In combination with cotton, silk is used for underclothing, and it has the advantage of being a bad conductor of heat, and is less irritating to the skin than wool. It does not shrink, but it is much more expensive than wool.

Cotton is a material obtained from the seeds of the cotton plant, and its fibres under the microscope are seen to be flat, like a ribbon, which looks folded or twisted. Materials made from cotton are calico, flannelette, muslin, velveteen, zephyrs. It is not a good material for underclothing, because it conducts heat rapidly. Flannelette is very much used by those who cannot afford wool. It appears woolly or fleecy, because the surface is raised, so as to make it soft. Its disadvantages are, that it rapidly absorbs and retains moisture, whilst it is a good conductor of heat, although it conducts heat more slowly than plain calico. Flannelette also catches fire easily, and is the cause of a considerable number of accidents, but various kinds of non-inflammable flannelette are now on the market.

Linen is a material made up of round jointed fibres, which are obtained from the flax plant. It conducts heat even more rapidly than cotton, and it retains the moisture of perspiration. Certain manufacturers now produce porous linen, which is more hygienic than the usual material.

Mesh materials are used a good deal in summer, and cotton mesh is certainly more advantageous than a cotton garment,

because it retains air more in the meshes than is possible between the close, parallel fibres of ordinary cotton material. At the same time, a loosely woven woollen combination is the best garment for wearing next the skin. Children, at least, should wear combinations all the year round, of very light wool, with short sleeves in summer, and long-sleeved combinations, of perhaps a heavier make, in winter.

COLOUR.

There is a very prevalent idea that dark clothing is more suitable in winter, because dark colours absorb heat better. Another supposed advantage of dark clothing is that it does not "show the dirt," and there is no doubt that light clothing is more hygienic, in that it must be more frequently washed. In summer, light colours are generally adopted, but white is most popular. Red and yellow, although anything but cool to the eye, are excellent colours in summer, as they prevent the actinic rays of the sun from reaching the body. These colours are popular in many Eastern countries, whilst an army doctor recommended a few years ago that red should be used as a lining for sun helmets. Black is also said to protect the body from the actinic rays. Light materials are more hygienic, because they show clearly when they are soiled. At the same time, dark clothes, even coats and skirts of black or blue, can be cleaned, and they well repay, from the hygienic, the artistic, and the economical standpoints, the cost of regular cleaning.

CHAPTER XXVII

GARMENTS

Corsets—Foot-gear—Head-gear—Night apparel.

THE advisability of wearing corsets has been much discussed by medical and hygienic experts. A special commission was appointed recently by the Institute of Hygiene to consider the question, which came to the conclusion that the requirements of modern dress and of modern civilisation appeared to make the wearing of corsets a necessity to the majority of women. The spread of knowledge regarding the need of physical exercise and freedom of movement has practically abolished the rigid " stay " corset of the past, and modern corsets are lighter and more flexible, and are constructed on hygienic lines. At the same time, corsets are frequently so constructed and so worn as to produce injurious compression, to interfere with respiration, circulation, and digestion. The ribs play a very important part in breathing, and the pressure of tight-fitting corsets upon the soft, yielding ribs of growing girls may produce permanent deformity. Pressure upon the lower part of the lungs prevents their expansion, and pressure upon the abdomen still further reduces the amount of abdominal respiration, which must have a deleterious effect upon health.

The Hygienic Corset must have certain characteristics: (1) It should be flexible, and allow free movement in every direction; (2) it should exert no pressure on the ribs or on the upper part of the abdomen. It should be so constructed as to exert pressure only on the lower part of the abdomen, and this pressure should be directed upwards and backwards. (3) It should be made absolutely comfortable to the wearer, whether in a sitting or standing posture. (4) The only corset suitable for a young girl is one made of washing material,

which is free from stiffening and loose, and which gives some measure of support, and permits of complete freedom of movement. (5) Corsets should only be purchased if they conform to careful measurements, and they should be made of easily cleaned material,. whilst any stiffening should be of a kind that will not rust.

Putting on of Corsets.—The back lacing of the corset should be opened widely, and the garment fastened from below upwards. In fastening the suspenders, the corsets should be pulled as low down upon the body as possible, then the back laces should be adjusted, working towards the waist line from below and from above.

Removing the Corset.—The back laces should first be loosened, then the busks unfastened, and the corset should be hung over a chair all night to air.

FOOT-GEAR.

The best materials for stockings are light wool or silk, or a mixture of the two. Cotton hose, by retaining moisture, are apt to cause chill from damp feet. The feet ought to be warmly clad in winter. Thin stockings cause many "colds," which may be a forerunner of more serious ailments. The colour is partly a matter of taste. Light-coloured stockings are chiefly advantageous, in that they show when they are soiled, and therefore must be more frequently changed. The most hygienic practice is to wear fresh stockings every day, but if this is not possible they should be changed at least twice a week.

The shape of boots should conform to the natural contour of the foot. "Pointed toes" produce cramping of the feet, and interfere with the circulation. The inner side of the boot or shoe should follow a straight line, and whilst "broad toes" are not essential, the front part of the boot must be roomy enough to allow the toes to lie in a natural position. The *heel* ought to be placed in the region of the natural heel—that is, at the back of the boot—and it should be broad and only moderately high. A high heel, tapering almost to a point somewhere about the middle area of the foot, is unhygienic in every respect, and from the æsthetic point of view it has no claim to beauty. The foot is raised upon an insecure basis, and the risk of accident is con-

sequently increased, as the heel is apt to be caught upon the edge of a stair or pavement, and the ankle may go over, causing strain or sprain. The wearing of high heels means that the body is tilted forwards, the toes being crushed into the apex of the boot, and the whole body is carried at an abnormal angle. There is some risk of spinal deformity, whilst all the organs are tilted in the wrong direction. The posture is unhygienic in every sense of the word. *Well-soled shoes and boots* have an important bearing upon health. Soles that are impervious to damp protect us from chills, and conserve the vitality of the body. It is a good plan to wear rubber over shoes in wet weather, which can be removed on reaching school or office; thus the feet are kept dry, when it is impossible to change into house-slippers. Thin soles are preferable in summer, and they have an advantage in being lighter than thick-soled, heavier boots, but they do not protect the feet so well from cold and damp. All foot-gear should be regularly inspected, and the soles repaired or renewed when necessary.

HEAD-GEAR.

Whilst it may be said with some truth that hats are superfluous articles of apparel, because Nature has provided our heads with a natural covering of hair, hats are generally worn for many reasons. In the first place, they protect the hair from wet. They serve to protect us from the hot rays of the sun, and they act as a shade to the eyes. They are also, under certain circumstances, ornamental or decorative. Heavy hats constrict the scalp, evaporation is interfered with, the weight produces headache, and at least causes unnecessary fatigue. The constriction, as we have said, interferes with the circulation of the scalp and the nourishment of the hair bulbs. In summer a broad-brimmed hat is a protection against sunstroke, because it shades the eyes and the nape of the neck, and it also helps to prevent burning of the skin by the sun's rays, which may cause irritation and even inflammation.

NIGHT-WEAR.

What has been said about the different materials for underclothing apply also to night-wear. Children should wear woollen night-dresses, or, better still, pyjamas, all the year round. The material can be of thin wool in summer. Older

people generally prefer night-clothes to be made of such material as thin nainsook in hot weather. Anyone with a rheumaticky tendency, however, should wear light wool at night. All clothing which has been worn during the day should be removed at night. The bed-clothing should be sufficient, but not unduly heavy. At the same time, many people sleep badly because they have too few or too light blankets, and scorn an eiderdown. Linen sheets are " cooler " in summer, and cotton, perhaps, more suitable for winter, as it has not the chilly effect upon the skin that linen has in cold weather. A fairly firm hair mattress on top of a spring mattress, and a moderately high pillow, comprise the remaining furnishings of the bed.

CHAPTER XXVIII

IMPORTANCE OF PHYSICAL CULTURE

Movement—Relation of muscular and nervous systems—Influence of physical training on function—Exercise—Games—Exercises for developing the body and limbs—Breathing exercises.

THE student must refer to the physiology section for a certain amount of information with regard to muscles, bones, and joints. All movements in the body are accomplished by the contraction of muscles. Voluntary movements are produced as a rule by muscles acting upon a bone as a *lever*, a lever being defined as a rigid bar which can be moved about a fixed point, called the *fulcrum*. The body moving the lever is generally called the *weight*, and the force producing movement is referred to as the *power*. For example, if the body is raised on tip-toe, the force or power is represented by the muscles at the back of the leg, which raise the heel. The toes form the fulcrum and the body itself is the weight. The movement of the biceps muscles represents another type of lever: the contracting biceps is the power, the elbow-joint is the fulcrum, and the arm which is lifted is the weight. Of the various kinds of movements which are brought about by the muscles acting on bones and joints, we have *extension*, when a limb is stretched out straight; *flexion*, when a limb is bent at a joint towards the body; *abduction*, when a limb is raised sideways away from the body; and *adduction*, when it is lowered again towards the body. Certain bones, such as the humerus, can *rotate* on their own axis. The limb also can be *elevated—i.e.*, when we stretch the arm up as far as possible and raise the shoulders, whilst at the ball-and-socket joints, of which the shoulder is the best example, *circumlocution* or universal movements can take place.

Relation of Muscular and Nervous Systems.—Passing to every muscle we have a motor or efferent nerve which carries messages from the brain or spinal cord. If we *will* to raise the right arm, a message has to be sent from the area of the brain controlling motion in that limb (in this case the middle area on the left side, because the fibres cross in the medulla) downwards through the base of the brain and through the spinal cord, and outwards by the nerves going to the muscles of the right arm and forearm. If this motor nerve were cut or destroyed by disease at any part of its course, the muscles which it supplies would be paralysed, and incapable of producing any movement.

INFLUENCE OF PHYSICAL TRAINING ON FUNCTION.

Exercise is essential to health and development. If a limb is deprived of exercise, it atrophies, or wastes, from disease. If, for example, you kept the left arm fastened to the side for some months, it would shrink, the muscles would become flabby and thin, and the skin loose and discoloured. Regular exercise, on the other hand, will develop the muscular system, because muscles, like people, require a definite amount of work for health. The biceps of the tennis player, the well-developed leg muscles of the athlete who runs, the magnificent development of the perfectly trained person, are proofs that muscles *can* be gradually increased in size and power. Exercise also stimulates the circulation, and, provided excess is avoided, it strengthens the heart. The danger of excessive exercise is, that whilst the heart " hypertrophies," or increases, in size to meet the increased strain up to a certain point, it may fail, and " dilatation," indicating heart weakness, may result. Moderate exercise also stimulates the organs, increases the size and development of the lungs, and enlarges the chest. By rapidly getting rid of waste products from the body, by causing a sort of internal massage of the organs of digestion, and stimulating the appetite, it improves the tone of the digestive system. As blood is circulating more rapidly through all the tissues, the glands are stimulated, and there is increased secretion. The excretory system is also more active, because, in exercise of the muscles, certain products of fatigue develop and have to be got rid of, also exercise produces heat, the skin perspires, and poisons are rapidly got rid

of in this way. It has become a platitude to say that over-exercise must be avoided. But it cannot be too frequently repeated, that whilst moderate exercise will improve the vitality and the health of every organ in the body, exercise carried to the point of fatigue and strain may do irreparable damage.

EXERCISE.

Physical culture may be divided into natural exercise and games, and the culture represented by various exercises, which are followed in the gymnasium or the home. Amongst natural exercises we may include walking, running, rowing, and swimming. **Walking** is the ideal exercise, because it gradually strengthens the heart, it exercises a large number of muscles without strain to the organs, and it can be obtained by everyone. If we take the minimum amount of exercise essential for health, it may be stated in five miles walking exercise per day or its equivalent. Some people prefer **cycling** as an exercise, which has many advantages ; its chief disadvantages being that it is apt to be carried to the point of fatigue and heart-strain, and that it encourages in certain people wrong positions and round shoulders. A girl should be particularly careful to have a comfortable, well-made saddle, placed in such a position that she can ride easily and erect, with the shoulders braced and the head well up. **Rowing** is a useful exercise for developing the chest and arms. The lower part of the body, however, is apt to be neglected if this is the only form of exercise engaged in. Training in rowing must be gradual to avoid heart-strain. Its chief advantages are that it takes a person into the open air, and encourages deep breathing. **Swimming** is not only a desirable exercise and an accomplishment, but it is a necessity, in the sense that every boy and girl should be taught to swim, as the capacity to keep afloat and to move about in deep water may mean self-preservation sometimes, or even the saving of the life of others. Swimming is a splendid exercise, because it develops the body, legs, and arms. It gives poise and grace to the figure, and provides a means of general development of the whole body. **Running and jumping** can be practised in moderation, and if sensible precautions are taken against overstrain.

OUTDOOR GAMES.

The old idea that girls should not be taught sport or physical culture has passed away, and in some quarters the danger is that we may be going to the other extreme. It is more dangerous for girls to overstrain than for boys, but no girl can develop physically on the best lines without playing games.

Hockey, whilst admirable in many respects, is unsuited to the girl of delicate physique, and it has certain disadvantages, in that it is apt to induce over-fatigue and lethargy, especially if it is played once or twice a week, and very little exercise is taken in the intervals. **Cricket**, on the other hand, is a first-rate game for girls, even when they are quite young, so long as it is modified for little children in the way of providing a shorter pitch, a lighter bat, and a soft ball. **Tennis:** Of other games suitable for girls, lawn-tennis occupies a high place. It makes for graceful development, gives poise or the sense of balance, trains the eye, and develops dexterity and co-ordination of the muscles. **Fencing** is also an excellent exercise for girls of over twelve. **Croquet** provides exercise of a gentle type, particularly suitable for girls who are not robust enough to go in for hard games. The same thing is true of **golf**, so long as it is regulated, so as not to over-fatigue.

Special Exercises may be utilised for training various muscles. The following exercises are particularly suitable for young girls. The young girl of ten or twelve is just approaching the "gawky" stage, and her natural awkwardness can be counteracted to a great extent by some such exercises as these:

1. Whilst standing with the heels together and the arms hanging, raise the arms level with the shoulders and crouch down Japanese fashion on the heels. Rise slowly to the original position.

2. Raise the two arms above the head, and while moving the left foot slowly forwards bend the arms and shoulders over to the left. Return to the original position and repeat to the right.

Some degree of **round shoulders,** and even slight curvature of the spine, is fairly common in early youth, as a result

of bad habits of posture and slouching. A knowledge of certain simple exercise will help to prevent this condition.

1. *Lunging.*—Stand easily with the heels together. Take one step to the right, with the right arm outstretched as far as it will go, then return to the first position. In the same way stretch to the left, with the left arm raised level with the shoulder. Repeat ten times.

2. *Bending.*—With the hands on hips, bend first to the left and then to the right, and repeat. Then in the same way bend as far forwards as possible, and as far backwards.

3. *Rolling the Shoulders.*—When there is a tendency to round shoulders, an excellent exercise consists in clasping the hands loosely, low down behind, and whilst taking a deep breath, roll the shoulders backwards, relax, and repeat. An effort should be made to bring the shoulder-blades as near each other as possible. This exercise strengthens the muscles which hold the shoulder-blades firmly against the ribs, and corrects "winged" scapulæ.

Breathing Exercises are specially recommended for developing the lungs and chest. In ordinary shallow breathing, those parts of the lungs which reach above the collar-bone (the apices) are in most cases little, if at all, expanded. If a long, deep breath is taken, the air is carried to all parts of the lungs, and deep breathing helps to prevent the onset of consumption of the lung (which frequently begins in the apices). Breathing exercises of the following type are excellent for lung and chest development:

(*a*) Stand straight with the feet together and the hands resting on the hips just above the waist on each side. Take a deep breath with the mouth closed, hold it for four seconds, and then slowly let the breath go. Repeat these exercises twelve times.

(*b*) With the arms hanging, the mouth closed, and the head erect, take a deep breath, whilst raising the arms at the same time until they are stretched above the head, holding the breath for four seconds, and slowly letting it go, whilst the arms fall to the sides.

Exercises for the Abdomen.—Whilst bending exercises help to develop the muscles of the abdomen, the following will be found very useful as a special exercise which helps also to cure constipation:

(*a*) Lie flat on a couch or on the floor, raise yourself to a sitting position without, if possible, any assistance from the hands. Repeat.

(*b*) Lie flat and try to raise the body against a resistance. Another person should hold her hands against your hands and resist your efforts to rise, just sufficiently to make you exercise considerable effort.

Exercises for the Back.—The bending exercises, and those described for counteracting round shoulders, act also upon the muscles of the back. Other exercises for the muscles of the spine consist in standing erect, and whilst taking a long, deep breath, pushing the arms as far as possible behind the body, holding them stiffly outstretched level with the shoulders.

Head and Neck Exercises are useful for developing the neck and giving a graceful poise to the head.

(*a*) With the arms hanging by the side, bend the neck as far backwards as possible. Bring it slowly forwards until the chin nearly touches the chest. Repeat. (*b*) Turn the head slowly and steadily, as far as possible to the right and then to the left. Repeat. In doing these exercises breathe deeply all the time.

CHAPTER XXIX

HEALTH IN TRAINING

Ambidexterity—Hints in Physical training—Swedish Drill—Apparatus Exercises—Calisthenics.

WHILST advocating ambidexterity in the sense of the need of the better training of the left side, it is necessary to say that it is undesirable to aim at an absolutely similar standard physically for the two sides of the body. The two hands should be interdependent, with, however, equal facilities for developing on the best lines and according to their special needs. We have in the past neglected the left side. Our work is more adapted to the freer use of the right hand for skilful tasks, but we have artificially developed the supremacy of the right hand in our games and our educational physical exercises. In the animal kingdom we find very little distinction between the left and right sides, even amongst the apes, whilst children use their right and left hands and sides indiscriminately. Gradually, and probably wrongly, we "educate" them into a preference for the right hand on all occasions. Many physical culture authorities are advocating a more "*natural*" condition of affairs, and insisting upon left-side exercises in order to provide better training for the left hand and the left side of the body. We know that "use" of muscles means a certain amount of brain development, and it is suggested that in neglecting the left side as we have done in the past, the nervous as well as the muscular system has suffered. There can, at least, be no objection (1) to the better education of the left hand, by teaching children to write or sew with the left hand sometimes as well as with the right; (2) to practising a few exercises with the left hand and arm and side, and using the left arm occasionally for tennis or Badminton.

The following is an excellent exercise for the left side, and others can quite easily be added by anyone who wishes to practise left-side training: Stand straight with the arms by the side, take a long breath, bend the body backwards, and raise the left arm high above the head, carrying it as far back as possible, keeping the right arm relaxed by the side all the time. In letting the arm fall to the side the breath is slowly expired.

Neck and arm exercises can be practised also for the left side, and breathing exercises for the left nostril, as well as exercises for the left leg, can be included.

HEALTH HINTS IN PHYSICAL TRAINING.

In taking up any system of physical training, the first point is *regulation.* All exercises should be gradually followed out, increasing the amount of energy and effort expended day by day. Many people injure themselves by going in for strenuous exercise to which they are unused, after leading a sedentary life for weeks or months. In the second place, exercise should never be carried to the point of *over-fatigue.* When sufficient exercise is taken, it induces exhilaration, followed by a pleasing sense of muscular fatigue, which is beneficial. When exercise induces faintness, depression, or such symptoms as headache, it is doing harm. Excessive exercise will injure the nervous system and may cripple the heart.

We must, in the third place, follow the physiological law—after exercise, *rest.* When, after games or physical exercise, a certain time can be set apart for rest and relaxation, better results will be anticipated, than if one passed immediately from muscular exercise to mental work.

Another point is to regulate *diet* during any course of training. Athletes find that a light, nourishing diet of foods which do not entail a strain on digestion are the most suitable. Anything in the shape of luxurious living has to be given up. Such foods as eggs, milk, and cheese are more suitable in physical training than stodgy meals of meat and rich, sweet foods. Food should never be taken immediately before exercise, nor immediately after. Those who are in training find it inadvisable to go in for violent exercise within two hours after a meal.

Clothing also must be adapted to exercise. Girls will find that short, well-cut skirts, neither too narrow nor too wide, combined with a sports blouse or jersey, are most comfortable, and therefore most suitable. Underskirts are neither necessary nor desirable. Knickers, fastened to a vest, with very light and loose corsets, and a silk or thin wool vest beneath, provide perhaps the best types of garments to wear in physical exercise.

SWEDISH DRILL.

Some of the exercises already described in this section would come under the heading of Swedish drill, which aims at teaching correct position and carriage, balance, training of the muscles of both sides of the body and of the limbs. The principle of Swedish drill is to gradually provide exercise which will develop all the muscles of the body—*progressive exercise* as it were, so that a student passes from the easy to the more difficult, from the simple to the complex. The system is so arranged that it can be adapted to young and old, and after a number of rapid muscular movements have been gone through, the pupil has to practise deep breathing in order to induce relaxation of the nervous and muscular system. Swedish drill requires very little room and no apparatus, and it is carried on in many institutions and by more than one Government. The movements are of all types and descriptions, from simply raising the heels to an elaborate movement, such as is entailed in the following: Kneel on the left knee with the right foot resting on the ground, bend the body backwards, raising the arms above the head.

At the same time no system, however perfect, can be adopted solely as a means of physical culture, because it cannot give the initiative and mental training which games, properly carried out, provide.

APPARATUS EXERCISES.

The same thing is true of apparatus work, such as dumb-bell exercises. In the first place, the dumb-bells ought to be adapted in weight and size to the needs of each pupil, which can rarely be done. Such exercises, also, are apt to be carried out mechanically, without interest. And

in the third place, a pupil goes on exercising for a definite time, and there is no means of judging whether the exercises are or are not overstraining the heart. Other exercises carried out by means of apparatus, such as indian clubs, come under the same category, and there is no doubt that the tendency nowadays is to prefer regulated games and dancing to physical training.

CALISTHENICS.

Calisthenics may be defined as exercises arranged for the purpose of promoting grace and poise as well as strength of body, the word being derived from the Greek *kalos*, beautiful, and *sthenos*, strength. So that under the term " calisthenics " we may include practically all accepted forms of exercise and drill, because the exponents of different systems would claim that they make for strength and beauty—rope-climbing, musical drill, fencing, parallel bars, apparatus work of all kinds, and, above all, dancing. There is no doubt that dancing, properly taught, ought to supply almost all the exercise or physical training necessary, apart from games.

Eurythmics has already been introduced into at least one of the most important girls' colleges with entire success. The children are taught to interpret music in movement, and they are gradually led by a progressive system from interpretation of simple music until they are able to express a Bach's fugue. They wear a loose black combination garment, and dance with bare legs and feet, the arms also being absolutely unrestrained by clothing. And one has only to see a class going through a course of eurythmics to realise its value in conferring freedom and joy in movement, which are so necessary in view of the many repressing influences of our accepted educational system.

CHAPTER XXX

THE NURSE AND SICK-ROOM

The sick-room—Characteristics of a good nurse—The bed—Changing the sheets.

If a case of illness has to be nursed in a private house, the first step is to obtain as hygienic a sick-room as possible. A room with a southern aspect should be chosen, not only because it is lighter and more cheerful, but because of the special action of the sun's rays on the germs of disease. A sick-room must have a fireplace and windows which open top and bottom, and, in cases of infectious disease, the patient should be segregated from the other occupants of the house. From what has been said regarding ventilation and the necessity for each person having 1,000 cubic feet of air-space as the minimum allowance, a room which has to accommodate a nurse and patient should have at least an air capacity of 2,000 cubic feet. This would be represented by a room 12 feet (width), by 16 feet (length), by 10 feet (height). The room is first cleared of superfluous articles of furniture—ornaments, books, carpets, and hangings. The window should be opened from the top, or air allowed to enter by the Hinckes-Bird system (see p. 55). A fire should be kept burning in the grate to encourage the passage of foul air from the room by the chimney, and also to warm the room, and maintain it at a temperature of about 60° F. The temperature should be regulated by a thermometer, which should hang on the wall behind the patient's head. The best form of lighting the sick-room is by electricity. If gas or lamps have to be used, the nurse must remember the necessity for good ventilation, because such methods of lighting use up a large amount of oxygen. Light and shade

must be varied according to the needs of the patient. A dark blind is very useful; a Venetian blind allows shade and ventilation if the window is open, because the air is directed upwards between the slits. The bed should be so placed that the light comes from behind or from the side. The best form of bed is a single low bedstead, of the type used in hospitals. In case of long illness, a double wire mattress serves to keep the bed rigid. This should be covered with a piece of canvas material, and then with a hair mattress. The bed should lie with the head against a partition or inside wall, and with the foot towards the centre of the room, towards the fire, if possible.

Characteristics of a Good Nurse.—The most important quality or characteristic of a sick-nurse, whether amateur or professional, is efficiency. Whilst patience, kindness, cheerfulness, are desirable qualities, of course, the fundamental necessity in nursing, as in all work, is sound knowledge. But even without a hospital training, the amateur can acquire such information as will make her efficient when nursing a sick person in the home. She must first learn accuracy and exactness, and to this end she should keep a notebook or report-book, in which are written all instructions given by the doctor. The best plan is to write various headings along the top of the page for the day —*i.e.*, pulse, temperature, food, medicine, etc.—and draw pencil lines to form columns. Down the left side of the page the hours are written—1 a.m., 2 a.m., 3 a.m., etc.—and so information can be quickly and accurately noted at any moment. A nurse's duties are very comprehensive. She must know how to wash and dress the patient, make the bed, take the temperature and pulse, make poultices and fomentations, prepare and serve meals, and use disinfectants intelligently.

Washing and Bathing the Patient.—Before beginning to wash the patient, have everything ready—basin, hot and cold water, soap, face flannel, body flannel, towels, change of clothing, which must be thoroughly aired and warmed. Remove the bedclothes, leaving the patient covered with a thin blanket.

First wash and dry the face, the chest, neck and arms, then the lower limbs, and the abdomen should be washed

and dried separately. The back can be washed and dried by turning the patient first on one side and then on the other. Dress the patient in the aired night-clothes, remove the under blanket and rough towel, which may be conveniently put under the patient before beginning washing operations, then change the bed.

To Change Upper Sheet.—Remove the bedspread and top blanket. Lay the clean aired sheet over the remaining blanket, and on it place another blanket. Hold this close up to the patient's chin, and with the other hand remove the lower sheet and remaining blanket, which latter is placed on top of the blanket now on the bed, then spread the counterpane over the whole.

To Change Lower Sheet.—Roll the patient to one side of the bed, remove the pillow and bolster, turn back the bed-clothes. Roll the soiled sheet lengthways, so that the roll is lying against the patient's back. Take a clean aired sheet, roll half of it lengthways, and place this roll against the soiled roll at the patient's back; tuck half of the clean sheet over the mattress in place. Roll the patient over on to the clean half of the bed; the soiled sheet can then be pulled away, the clean sheet unrolled and tucked in place. In surgical cases, where it is impossible to turn the patient from side to side, the sheet is changed by rolling it from the top, and passing it under the patient's shoulders, hips, and limbs, the clean sheet being unrolled into place, and tucked down all round, when the dirty sheet has been removed from the bed.

A Draw-Sheet.—When there is much perspiration or frequent staining of the under sheet, it is best to use a draw-sheet. This is simply a sheet folded so as to be wide enough to reach from the patient's shoulders to the knees. It is changed in the same method as the under sheet, or it may be so arranged that half of it is rolled up under the mattress on one side; then, instead of changing it entirely, the other end can be drawn through and tucked in, so that the patient lies upon a clean part.

CHAPTER XXXI

MEDICINES

Care of medicine bottles—Measurement tables—Alcohol—The temperature and pulse—Bed-sores.

THE nurse must be careful in administering medicines to the patient. All medicine bottles must be neatly arranged, with the poisons in poison bottles under lock and key, and the medicine should always be given by the chief person in charge. Medicines must be administered in a measured medicine glass, and the nurse should read the label before giving a dose. The following measurement table must be committed to memory:

60 grains	=	1 drachm, or small teaspoonful.
60 minims	=	1 fluid drachm, or small teaspoonful.
2 fluid drachms	=	1 small dessertspoonful.
4 fluid drachms	=	1 small tablespoonful, or ½ ounce.
8 fluid drachms	=	2 small tablespoonfuls, or 1 ounce.
16 ounces	=	1 pound.
20 ounces	=	1 pint.
A wineglassful	=	About 2 fluid ounces.
A teacupful	=	About 5 fluid ounces.
A breakfast cupful	=	About 8 fluid ounces.
A large tumbler	=	About 10 fluid ounces, or ½ pint.

Alcohol may be ordered by the doctor. It should never be prescribed by the nurse or by friends of the patient. If stimulants seem to be necessary, give hot tea, coffee, soup, or milk; hot bottles for the feet, and a hot water-bag over the stomach. The nurse requires to be tactful in giving medicines, which should not be unnecessarily disagreeable. Castor-oil should be administered in capsules, or, if given as a liquid, it may be taken in a little strong coffee, followed by a drink of black coffee. Powders can be given in milk or water, and if a pill is administered,

the patient should be told to put it at the back of the tongue and take a drink of water. Cod-liver oil may be taken by pouring the prescribed quantity on to the centre of the juice of half a lemon squeezed into a wineglass.

The Temperature.—The normal temperature in the armpit is 98·4° F. When the temperature rises, the person feels hot, shivery, restless, and headachy. In acute fevers the temperature may rise to 103° or more. When it reaches 105° the patient is seriously ill. A thermometer for registering temperature consists of a bulb and stem. The bulb contains mercury, which is separated from the thread of mercury in the stem by a tiny bubble of air. When the bulb is placed against the skin, the thread of mercury rises in the stem, until it registers the degree of heat in the body. The temperature may be taken under the armpit, in the groin, or in the mouth. It is taken, as a rule, in the armpit.

To Take the Temperature.—Shake the thermometer until the mercury lies at the level of 95° or 96°. Dry the patient's armpit, place the bulb in the centre of the armpit, pull the arm over the chest, cover the patient with the bedclothes, and let the thermometer remain in position for three minutes. Examine the thermometer, holding it in the right hand, the bulb pointing towards the left. If the temperature is normal, the mercury stands at the arrow. If the patient is "fevered," the thermometer registers 99° or more. The exact temperature should be written in the nurse's chart at once. If the temperature is taken in the mouth, the bulb is placed beneath the tongue, and the patient closes the lips. The thermometer must be washed in tepid water after using.

The Pulse.—The nurse must count the pulse by placing the tips of two fingers about half an inch from the outer border of the patient's wrist on the thumb side. She should hold a watch with a seconds hand in the other hand, and count carefully for half a minute. By doubling the number of beats the rapidity of the pulse per minute can be estimated. The normal pulse of an adult person is 70 or 80 beats per minute. The rate is more rapid in childhood—perhaps 90—whilst in infancy it may beat as fast as 100.

BED-SORES.

Absolute cleanliness will in most cases prevent bed-sores, which are caused by pressure when the vitality of the tissues is low, especially if damp bedclothes or bedding are not immediately changed. Bed-sores most frequently appear on the back and shoulders, the hips and elbows. The position of the patient should be changed frequently, and, if necessary, an air-pillow or water-bed should be supplied. Any reddened, suspicious part should be washed with methylated spirit two or three times a day to harden the skin, and then dusted with boracic powder. If the skin is broken, the part should be painted with collodion; and when a sore forms, it must be washed with boracic lotion and dressed with boracic ointment on lint.

CHAPTER XXXII

SICK-ROOM REMEDIES AND BANDAGING

Fomentations and poultices—Various kinds of poultices—Roller bandaging—Bandaging joints, etc.

THE application of heat is frequently employed in the sick-room to soothe pain, to arrest sickness, to counteract chill, or to relieve inflammation.

Dry Heat in the form of hot flannels, hot-water bottles, hot bran, etc., is useful in emergency for colic, neuralgia, chill, etc. **Moist Heat** is most usually applied in the form of fomentations and poultices.

Fomentations.—A hot fomentation is made as follows: Lay a roller towel across a basin, and place a folded piece of flannel in the centre of the towel. Pour *boiling* water on to the flannel, and fold the roller towel over it. One person stands at either end of the towel and twists the ends in opposite directions, until the flannel is wrung clear of water. The flannel is then shaken and applied at once to the patient. It should be covered with another layer of flannel, and a larger layer of waterproof tissue to prevent evaporation of moisture. A teaspoonful of laudanum, or half a teaspoonful of turpentine, sprinkled over the hot flannel, adds to its soothing effect. (Note that laudanum or tincture of opium is a poison.) When a fomentation is removed, the skin should be carefully dried, dusted with boracic powder, and covered with clean flannel or cotton-wool.

Poultices retain heat longer than fomentations, but they are heavier, more bulky, and more troublesome to make. They should never be applied to inflamed wounds or sores, as they encourage the propagation of bacteria or germs,

which may be reabsorbed into the patient's system and set up blood-poisoning. The best application for an inflamed wound is a pad of boracic lint, squeezed out of hot water and covered with oiled silk. A poultice is used to soothe pain, to relieve congestion, or to hasten the formation of pus or matter, in a later stage of inflammation. The poultice may be applied directly to the skin, or it may be covered with a layer of thin flannel. It is very important to have the poultice *hot*, not warm. The basin, spoon, and knife should be heated with boiling water, and the kettle full of boiling water should be at hand, so that the bread, etc., can be mixed with water that is actually *boiling*. A piece of lint, linen, cotton, or flannel, or even brown paper, is placed on the table, and it should be large enough to allow of an edge of about an inch all round overlapping the poultice. The poultice, when made, should spread easily on the material, and be just stiff enough to allow a spoon to stand upright in it before it is turned out of the basin. The heat should be tested by holding it against the nurse's cheek. When placed on the patient, it should be covered with a piece of flannel or a folded towel.

Linseed-Meal Poultice.—Pour a little boiling water into a heated basin. Stir gradually a handful of linseed meal into the water; add water and meal alternately, until the poultice is well mixed and large enough to spread about ½ inch thick. The surface of the poultice may be smeared with a little olive-oil.

Mustard and Linseed Poultices.—Equal parts of mustard and linseed-meal are worked into the paste with hot, *not* boiling, water. No poultice containing mustard should be applied directly to the skin. A thin layer of muslin should cover the poultice.

A Jacket Poultice consists of two linseed poultices, one applied to the front and the other to the back of the chest, kept in place by strips of material laid across each shoulder and pinned to the upper borders of the poultice. The poultices are further fastened together by tapes under each armpit. A jacket poultice is useful for inflammation of the lungs and bronchitis.

Bran Poultices are used for sprained joints, rheumatic joints, etc. They are made by mixing bran with boiling

water, the mixture being turned out upon a towel, and the excess of water allowed to run off. The painful part is laid in the centre of the steaming bran, and the towel wrapped tightly round the limb.

Boracic Poultices or *Boracic Fomentations* are useful for poulticing fingers. Two or three layers of boracic lint are soaked in hot boracic lotion (in the strength of a teaspoonful of boracic powder to ½ pint of water). Squeeze the lint free of water and apply to the finger. Cover with gutta-percha tissue. Wrap the finger in cotton-wool and a gauze bandage. In the early stages of inflamed finger this poultice will prevent suppuration, and later it will bring the gathering to a head and diminish pain.

Bread Poultice.—A piece of thick bread is crumbled into a basin and covered with boiling water. The excess of water is squeezed off, and the bread spread on lint. This poultice can be applied to the eyelids or the ear or the neck, if ordered by the doctor, as it has no smell, and it is very light.

ROLLER BANDAGES.

A roller bandage is used in the sick-room for keeping poultices in position, for retaining dressings and sprains, for supporting joints, etc. The roller bandage is easily applied if one is careful to remember the following rules:

1. Bandage limbs from below upwards—*i.e.*, from fingers to shoulder.

2. Stand facing the patient, holding the bandage in the right hand if you are bandaging the left side, and *vice versa.* Support the limb in the opposite hand, and apply the free end of the bandage to the limb.

3. Bandage from *within* outwards over the front of the limb. For example, in the case of the foot, carry the bandage over the front of the instep, round the back of the ankle to the inner side, then over the instep to the outer side of the little toe, thus fixing the bandage firmly. Carry the bandage to the inner side of the foot once more, and repeat, forming a figure of eight.

4. In bandaging the limb, always pass the bandage outwards over the front of the limb. Overlap the last turn by about half the width of the bandage.

5. As you reach the thick part of the limb, it is necessary to *reverse*, or the bandage will pucker. Place the thumb

of the hand supporting the limb against the lower edge of the bandage as it lies against the skin. Turn the head of the bandage or roll downwards, thus reversing it, and carry the bandage again round the limb. These reverses must be done over any thick part of the limb, such as the middle of the forearm, the calf of the leg, etc.

6. *To Bandage a Joint.*—On approaching a joint, take a simple turn just below, then pass the bandage round the limb over the middle of the joint—for example, over the kneecap. The next turn covers the lower half of this, and then the bandage is carried round the joint to cover the upper half of the turn which was carried over the centre of the joint. This forms a figure of eight, and it should be repeated once or twice. The leg is generally bandaged straight, but if the elbow is to be bandaged, the arms should first be bent at a right angle with the palm against the chest.

The Fingers and the Limbs are all bandaged in the same way. Care must be taken not to make the bandage too tight, or the circulation will be interrupted; or too loose, so as to allow the bandage to slip. When bandaging a cut finger or hand, the best plan is to leave a long end, which should be split up the middle, and fixed by passing the ends round the part and tying in a knot.

The best *materials* for bandaging are gauze, linen, crêpe, flannel (for rheumatic joints, strains, etc.).

CHAPTER XXXIII

FEEDING THE PATIENT

Peptonised foods—Milk diet—Diet in "fever"—Invalid drinks.

THE nurse must study the chapters on Food and Dietetics in order to have an intelligent knowledge of the various classes of foods. In an acute illness, food must be given in an easily digested form, and almost wholly liquid, to save the body the prolonged work of digesting solids. In certain illnesses—for example, typhoid fever—fatal results may follow the giving of such solid foods as beef or vegetables. During the acute stages of fever, liquid diet is prescribed, such as milk and soda-water, which is prepared by heating half a tumblerful of milk until it is nearly boiling, and adding an equal quantity of soda-water, the drink to be sipped whilst effervescing. In certain cases of illness it may be necessary to give the patient peptonised food.

How to Peptonise Milk.—Put into a clean jug ½ pint fresh milk, ½ pint cold water, and half a peptonising powder. Peptonising powders can be obtained from the chemist, ready for use in glass tubes. Place the jug in a basin of water, so hot that the hand can just bear it, for twenty minutes, shaking the mixture occasionally. It is then boiled to arrest the further action of the powder.

Peptonised Beef-Tea.—A pint of beef-tea is slightly warmed. A pinch of bicarbonate of soda is added, and half a peptonising powder. The mixture is poured into a covered jar, and it is placed near the fire so that it is kept just warm for three hours; the beef-tea is then brought to the boil in a saucepan. Other goods can be peptonised in the same way. The making of beef-tea and broths have been described under the section on Cooking. Although less nourishing than milk, these foods are useful in the sick-

room, because they contain considerable proteid or albumin, and they are warm and stimulating.

Milk Diet.—Milk which is diluted with barley-water, soda-water, or lime-water, is more easily digested, because the formation of large clots is prevented. Milk should be sipped slowly. It should be kept in a well-ventilated place, protected from dust. Every nurse should understand that milk is a nourishing food, and that patients can be kept on it alone for many weeks.

The following gives an idea of the diets useful at various periods of illness:

Low Diet or Fever Diet.—The patient gets at regular intervals stated by the doctor, milk, milk diluted with barley-water, albumin-water, broth or beef-tea, fresh whey, or one of the well-known patent invalid foods served with milk. One teacupful served every two hours is an average quantity.

Middle Diet.—This is prescribed when the temperature falls. Breakfast: A breakfast-cupful of milk, cocoa, or tea, bread or toast, and butter. Dinner: One pint of soup or broth with toast, and a little fish or egg, and milk-pudding. Tea: A tumblerful of milk with bread-and-butter, or arrowroot and milk, or gruel, or bread-and-butter. Supper: Milk or gruel.

Ordinary Diet.—A little fish or an egg is added to the breakfast menu. Tea and supper are the same as in middle diet.

For dinner, besides a pint of soup with bread, 4 ounces of freshly cooked meat or 6 ounces of fish are given with 6 ounces of potatoes. For pudding, a custard or lightly cooked milk-pudding may be given.

Invalid Drinks.—Patients often suffer intensely from thirst. It should be allayed by allowing them to sip water from a spoon, or by giving barley-water, toast-water, or lemonade. Iced fluids or cold drinks should not be drunk in quantity, but taken with a spoon or sipped through straw.

Barley-Water.—Wash 4 tablespoonfuls of pearl barley and put it in a jug. Pour a pint of boiling water over the barley, and strain when cold. Fresh lemon-juice and four lumps of sugar may be added.

Toast-Water.—Toast two slices of stale bread before a bright fire; put them in a jug, and pour over them a quantity of boiling water. Strain when cold, and add sugar and lemon if desired.

Rice-Water.—Place 6 tablespoonfuls of washed rice in a saucepan with 1½ pints of cold water. Simmer for ten minutes, and strain when cold.

Lemonade.—Put the outer part of the rind and juice of two lemons, with six lumps of sugar, in a jug. Add 1 quart of boiling water, and strain when cool.

See Chapter XXIV. for Invalid Cooking.

CHAPTER XXXIV

WINTER AILMENTS AND SURGICAL CASES

Cold in the head—Sore throat—Bronchitis—Pneumonia and Pleurisy—Rheumatism—The care of surgical cases—Preparing for the doctor—Cradles.

THE commonest winter ailments are colds and catarrhs, sore throat, pleurisy, bronchitis and pneumonia, and rheumatic affections. In winter the patient should wear a light woollen nightdress, and, if necessary, the chest and arms should be protected by a woollen jacket. In winter ailments, even in "cold in the head" of a severe type, the temperature is raised, and light diet and hot drinks, combined with external warmth, are necessary to make the circulation regain its normal condition, and to aid the elimination of poisons. Hot milk, gruel, broths, and arrowroot, are suitable foods for invalids in winter.

Cold in the Head.—So many winter ailments develop after cold in the head that a feverish cold should never be neglected. In the early stages a cold can sometimes be cut short by douching the nostrils with hot boracic lotion (a teaspoonful boracic powder to ½ pint). A glass nasal douche is filled with the hot solution, and the head is tilted backwards; the mouth should be kept open. A purgative should always be given at the beginning of a cold, and sweating should be induced by hot baths and hot drinks. The patient must go to bed afterwards, or he may contract chill. If deafness is associated with cold in the head, *inhalations* are very useful. An inhaler or an ordinary jug should be filled with hot water, to which is added half a teaspoonful of Friar's Balsam. The medicated steam is then inhaled.

A great deal can be done to prevent cold in the head, which is an infectious disease caused by microbic infection. Well-ventilated rooms, sunshine, fresh air, simple diet, sensible clothing, and daily exercise, all help to maintain health at a high level and make people resistant to germs.

Colds are spread from one to another by contact. When handkerchiefs are allowed to lie about, germs pass into the air, and are inhaled into the respiratory passages. Anyone suffering from catarrh of the nasal passages is in an infectious state, and liable to infect others; but the danger is lessened when hygienic care is exercised with regard to handkerchiefs and towels, and if rooms are well ventilated.

Sore Throat.—In cases of sore throat a doctor should be summoned, as the condition may be a commencing rheumatic fever, or severe tonsillitis, or diphtheria. The amateur nurse will find it safe to use a gargle consisting of a tumblerful of warm water, to which is added a teaspoonful of glycerine, a teaspoonful of borax, and a teaspoonful of tincture of myrrh.

Bronchitis is catarrh of the bronchial tubes associated with cough and difficult breathing. Inhalations are useful, and the doctor may wish a special bronchitis kettle to be used. It has a long spout, and if the kettle is placed on the fire, steam issues into the room. Various medicines are ordered by the doctor to be put into the kettle, such as Friar's Balsam, so that the steam is medicated in the sense that it holds various antiseptic particles in suspension.

Pneumonia is an inflammation of the lung tissue, associated with difficulty of breathing, pain, cough, etc. In nursing pneumonia, attention must be paid to the expectoration or sputum. It must be shown to the doctor, as the rusty-coloured spit of pneumonia is a diagnostic feature of the disease. Another feature of pneumonia is the sudden fall of temperature (" crisis ") which occurs on the seventh day. Rest in bed, suitable diet, protection from chill, will help towards a favourable issue. Hot poultices are useful remedies for the pain.

Pleurisy is inflammation of the pleural membrane, which encloses the lungs and lines the chest wall. Breathing is attended with a sharp knife-like pain, and there is cough and rise of temperature. The progress of the disease may

be slow, and the nurse must guard against chill, especially in convalescence, in order to avoid a relapse.

Rheumatism.—In *chronic rheumatism* the patient is not confined to bed. Nursing consists in attention to diet, to a hygienic mode of life, and to alleviating the pain. Rheumatic people should take very little flesh meat, and should wear light woollen underclothing. In *acute rheumatism* or rheumatic fever good nursing is very important. The temperature is generally very high; the patient suffers from pain in the joints and sweating. Flannel night-dresses should be worn, and the patient should sleep between blankets. The doctor will order fomentations for the joints. There is great risk of the heart being affected in rheumatic fever, and the nurse should immediately report any pain in the chest, palpitation, or breathlessness. Rise of temperature should also be reported at once.

The Care of Surgical Cases.—In nursing surgical cases—*i.e.*, fractures, accidents, wounds, etc.—the nurse has to be specially careful to have everything associated with the patient scrupulously clean or aseptic. A doctor will generally undertake the dressing of serious cases himself.

Preparing for the Doctor.—In dressing wounds, the following will be required: Hot and cold sterilised water (*i.e.*, water that has been boiled), lint, Gamgee tissue, cotton-wool, bandages. A glass-stoppered bottle containing boracic powder, or a bottle of carbolic acid (phenol), or other antiseptic, should also be placed in readiness for the doctor, with clean towels, basins, soap, nail-brush, etc.

Bed-Cradle.—In nursing surgical cases, it is often necessary to prevent pressure of the bed-clothing on the body or limbs. This can be done by means of a " cradle," which is made of metal or of wooden hoops fixed on supports, and wide enough to enclose the limb. A bed-cradle may be improvised from a three-legged stool or from a band-box with two sides cut out of it, so as to allow it to lie over the limb and support the blankets on top. In a case of fractures it is necessary to guard against bed-sores. This can be done by making a little nest of cotton-wool for the heel to rest in, and by careful padding of splints.

CHAPTER XXXV

INFECTIOUS DISEASES

Stages of fever—Description of infectious diseases—Isolation—Disinfection.

An infectious disease or a communicable disease is a disease caused by an infective organism which has the power of causing the disease special to itself and no other. For example, typhoid fever is caused by the typhoid bacillus, and scarlet fever by the scarlet fever germ. A person may be infected through—(1) The digestive tract, by water, or food. Typhoid fever and cholera are frequently contracted in this way. (2) The respiratory system, when the germ is taken into the air-passages, as in whooping-cough, consumption, or measles. (3) The skin. The bites of certain insects will convey infection. Mosquitoes convey malaria, whilst fleas and vermin carry plague. Hydrophobia is produced from the bite of a dog suffering from rabies. When an infective poison has been taken into the body, it sets up various symptoms after a certain time, described under the general term of "fever."

Stages of Fever.—For descriptive purposes fever is divided into stages: (1) The period of incubation, the time intervening between receiving the poison and the appearance of symptoms, when the germs are incubating in the body. (2) The period of invasion, when the symptoms of fever develop, high temperature, headache, sickness, etc. (3) The period of eruption—the rash appears. (4) The period of decline when the rash fades, the temperature falls, and the patient begins to recover. (5) The period of convalescence.

The chief infectious diseases are scarlet fever, measles, German measles, chicken-pox, small-pox, whooping-cough, mumps, typhoid fever, diphtheria, erysipelas. When

these occur in outbreaks, they are said to be epidemic; and to prevent epidemics, isolation of every patient exposed to infectious disease, and careful nursing of an infected person, are necessary. The symptoms of the different infectious diseases are somewhat similar in the early stages. The patient feels ill, and is perhaps sick and headachy. He may suffer from sore throat, constipation, or diarrhœa. In many cases it is not until the rash appears that the particular disease can be recognised. The table on pp. 182 and 183 gives the chief points of the different infectious diseases necessary for the amateur nurse to know.

How to Isolate a Patient.—The patient should be placed in a room (which has been cleaned and washed with a disinfectant fluid, and thoroughly aired), as far as possible from the other members of the family. There should be nothing in the room except what is required for the patient's use. Carpet and curtains must, of course, be removed. The window should be kept open day and night, and a fire burning. At the door of the sick-room a sheet kept damp with 1 in 20 solution of carbolic acid should be hung.

Disinfectants.—Certain substances can kill germs, and it is therefore important that all the excreta of an infectious patient should be treated with these chemicals or disinfectants. The best-known disinfectants are carbolic acid, corrosive sublimate, chloride of lime, Sanitas, and Condy's Fluid. Perhaps the most useful disinfectant is a solution of carbolic acid (1 in 20).

Hints on Disinfecting.—1. Disinfect discharges, including the expectoration, by adding an equal quantity of the disinfectant solution to the excreta.

2. Flush drains, sinks, closets, etc., with a strong disinfectant daily.

3. Disinfect utensils with the disinfectant solution.

4. Feeding utensils, cups, plates, etc., should be disinfected by putting them in a basin and pouring boiling water over them.

5. Place sheets, towels, nightdresses, etc., in a zinc bath full of the disinfectant solution, and let them remain for two or three hours.

6. Burn rags, swabs (pieces of cotton-wool or lint used to wipe away discharges) in the fire.

7. Cleanse the mouth of the patient two or three times

a day with warm water, to which has been added a few drops of Condy's Fluid or some boracic powder.

8. The nurse should keep a basin of 1 in 20 carbolic or Sanitas fluid and water to cleanse her hands after touching the patient.

9. In nursing infectious throat diseases, the nurse must be careful not to inhale the breath; whilst in scarlet fever the skin should be anointed with carbolised oil or carbolised vaseline to prevent the scales passing into the atmosphere.

Disinfecting the Patient.—A patient should be washed for three evenings before he leaves quarantine in a warm bath containing either Sanitas or Condy's Fluid, and scrubbed thoroughly with soap and water from head to foot. Before leaving the room he should take a bath, and after drying, slip on a dressing-gown, which has just been brought for the purpose, then go into another room and dress in fresh clothing.

Disinfecting the Room.—The room must be carefully disinfected after infectious disease in the following way: Close the windows, and paste any crevices over with brown paper. The chimney is blocked. The drawers should be moved out and stood on end, the mattress, etc., removed from the bed and placed against it. The blankets should be spread over chairs to be fumigated before being sent away for special disinfection. To disinfect an ordinary-sized room, $1\frac{1}{2}$ pounds of brimstone should be broken into small pieces and placed on a shovel. This should be supported by a pair of tongs, placed across a bucket or zinc bath filled with water. A tablespoonful of methylated spirits can be poured over the brimstone and set alight. Formalin tabloids may be used (thirty to every 1,000 cubic feet) instead. When leaving the room, shut the door, and paste the crevices and keyhole with brown paper. The room must be kept closed for twenty-four hours. Next day the walls and ceilings should be moistened with a solution of carbolic, and the paper scraped off; then the walls should be scrubbed with carbolic solution. The chimney must be swept, and a fire kept lighted for two or three days, and the windows left wide open to ventilate the room. The mattress should be opened, the tick destroyed, and the covers disinfected in carbolic solution, and then dried in the open air.

Disease.	Mode of Infection.	Incubation Period.	Symptoms.	Rash.
Scarlet fever	Discharges, clothing, toys, skin peelings, breath	1 to 7 days	Sore throat, enlarged glands beneath lower jaw. Tongue and throat red	Appears on 2nd day on chest; scarle mottling, re cheeks; fades or 5th day of fever
Measles	Breath or discharges from nose and ears	7 to 14 days	Early symptoms like common cold	Appears on 4th day on face; dull re blotches and swollen appearance
German measles	Breath and throat discharges	10 to 21 days	Sore throat, enlarged tonsils	Appears on 1st day round rose-pink spots on face and chest
Chicken-pox	By contact with patient	2 weeks	Feverish symptoms not very severe	Appears on 1st day on chest and body as groups of small red pimples, which become blisters
Small-pox	Through air, from skin, breath, and excretions	12 to 14 days	Constant shivering or "rigors." Pain in the back	Appears on 3rd day as red pimples on face, chest and exposed parts. Like vaccination pimples
Whooping-cough	Breath, clothing, discharges, etc.	6 to 10 days	Cough, followed by vomiting. Whoop may be absent	—
Mumps	By contact	2 to 3 weeks	Pain and swelling of glands in front of ear and under jaw	—
Typhoid fever	Discharges, water, milk, food, flies	2 to 3 weeks	Usually diarrhœa; temperature rises gradually, dropping slightly each morning	Scarlet spots on abdomen
Diphtheria or membranous croup	Breath and discharges	2 to 6 days	A membrane forms on back of throat and nose passages	—

Period of Illness.	Period of Infectivity.	Special Points in Nursing.	Complications.
10 days, if no complications	6 to 8 weeks, until peeling and discharges ceased	Disinfect everything that has been in contact with patient. Apply carbolised oil, vaseline, or cold cream to the skin. Avoid chill	Ear disease, inflammation of the kidneys and heart.
10 days	3 weeks; more infectious first few days	Avoid chill; keep patient warm, with room at 60° F.	Bronchitis and pneumonia; ear inflammation.
5 or 6 days	7 to 14 days	Guard against chill	No special complications.
5 to 7 days	14 days, or until skin clear	—	—
2 to 3 weeks	A month	Hygienic measures; vaccination	Bronchitis, pneumonia, inflammation of the eyes.
3 to 6 weeks or longer	Until whoop is absent	Careful disinfection and isolation	Hæmorrhage, as the result of strain; lung complications.
7 to 14 days	A fortnight	Keep patient in bed, and guard against chill	Inflammation of glands, etc.
3 to 4 weeks or longer	6 weeks or longer	Careful disinfection	Lung complications, hæmorrhage from bowels and perforation.
Varies	6 or 8 weeks or longer, or until bacilli proved absent	Careful disinfection. Keep away from patient's breath	Choking, collapse, paralysis.

CHAPTER XXXVI

BANDAGES AND STRETCHERS

Triangular, broad and narrow bandage—Large, small, and St. John's sling—Reef-knots—How to use the triangular bandage—Carrying patients—Stretchers.

THE student of first aid must study the chapters dealing with the construction and the physiology of the body. Before considering the treatment of accidents, she should learn how to make a triangular bandage, a broad bandage, a narrow bandage, and slings.

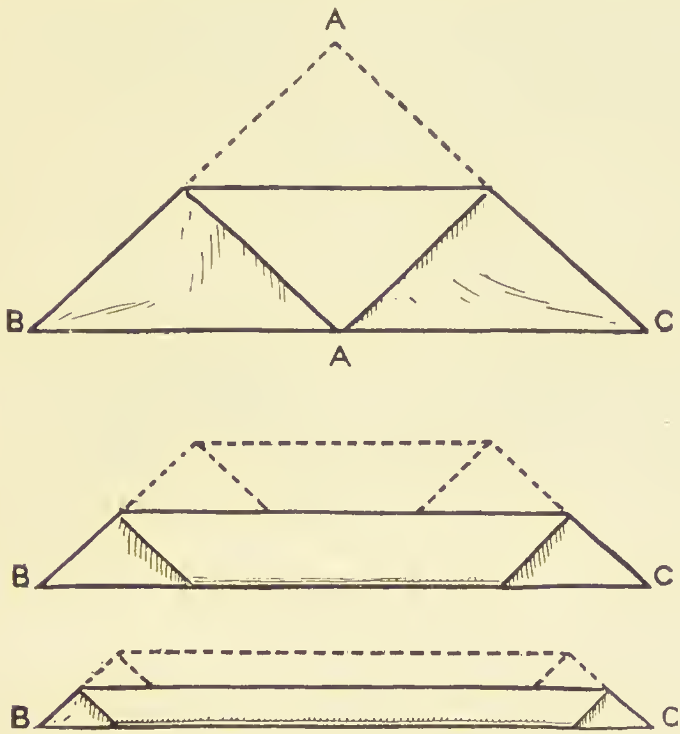
The Triangular Bandage is made by cutting a piece of linen or calico about 40 inches square diagonally, thus making two triangular bandages. The triangular bandage can be used in emergency to cover dressings or to bandage joints. It can also be converted into a broad or a narrow bandage, and into various slings.

A Broad Bandage is made by laying the triangular bandage on a flat surface and folding it, by bringing the apex of the bandage to the centre of the base. The bandage is again doubled by bringing the farther-off border to the base, thus forming a " broad bandage."

A Narrow Bandage is made by folding the broad bandage once more.

Large Arm Sling.—Put one end of the triangular bandage over the shoulder of the sound side, and pass it round the neck to the shoulder of the injured side. Let the other end hang downwards in front of the body, with the apex of the bandage towards the injured side. Bend the forearm over the middle of the bandage, and tie the two ends in front of the injured shoulder. Fold the apex neatly forwards over the elbow, and secure with two safety-pins.

Small Arm Sling.—Lay one end of a broad bandage on the sound shoulder, and bring it round the neck to appear in front of the injured shoulder. Bend the elbow so that the forearm lies at a right angle to the arm in front of the sling; tie the two ends in front of the injured shoulder.



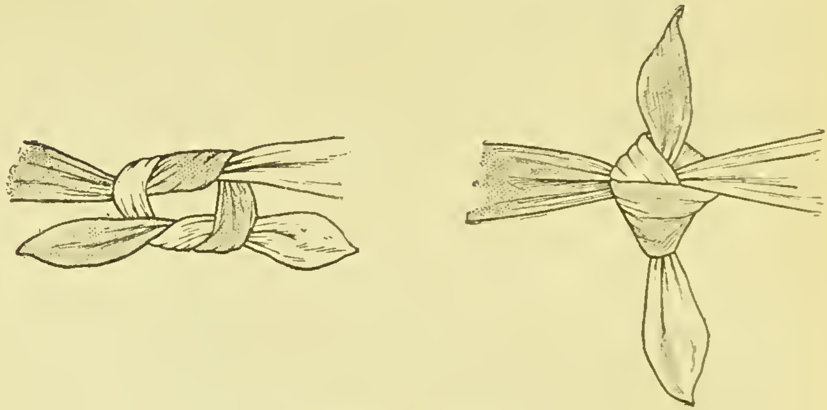
METHOD OF FOLDING TRIANGULAR BANDAGE, BROAD AND NARROW, FOR USE.

St. John's Sling.—Lay a triangular bandage across the chest, with one end over the sound side and the apex towards the elbow of the injured side. Pass the lower end of the bandage under the injured arm, up the back, and tie in front of the sound shoulder. Secure the apex over the elbow of the injured side.

Reef-Knots must always be used in first-aid work. A reef-knot is made as follows: Take the two ends of a narrow bandage in the right and left hand respectively, pass the right hand behind the left, and twist the end of

the bandage through. Pass this same end, which is now in the left hand, behind the end in the right hand, and twist it through.

"Reef" Knot.



"Granny" Knot.

FIRST-AID BANDAGE.

For the Scalp.—Fold a hem about 2 inches deep along the base of the triangular bandage. Stand behind the patient and lay the bandage on the head, so that the hem lies along the level of the eyebrows, and the point hangs down behind the head. Carry the ends round the head just above the ears and cross them over the apex at the nape of the neck; then tie them in front in the centre of the lower border of the bandage. Pull the apex-point firmly downwards, then turn it up and pin it to the bandage on the top of the head.

For the Hand.—Lay a triangular bandage on the table. Place the patient's hand, palm downwards, on the bandage, with the fingers towards the point. Bring the point over the wrist, gather the ends together, and pass them round

and round the wrist, finally tying them at the back of the wrist. Bring the point over the knot and pin it to the bandage on the hand.

For the Foot.—Place the foot on the centre of the bandage, with the toes towards the apex. Bring the point upwards over the toes and back of the foot and the front of the ankle. Gather the ends together and cross them over the back of the foot and again behind the ankle, tying them in front, pulling the apex upwards, and then folding it downwards to cover the knot, and pinning it to the bandage over the dorsum (back) of the foot.

For the Elbow.—Fold a hem along the base of the bandage, and lay the middle of the base along the back of the forearm, with the apex pointing upwards towards the shoulder. Cross the ends in front of the elbow, and tie them round the arm. Bring the apex downwards and pin it to the bandage on the forearm.

For the Knee.—Lay a triangular bandage over the front of the knee, with the apex above and the hem of the base below the knee. Cross the ends behind the knee, and tie them over the thigh. Bring the point down and pin it to the base.

For the Shoulder.—Place the triangular bandage on the shoulder, so that the apex lies against the neck and the hem of the base about the middle of the arm. Pass the ends of the base round the arm and tie them. Place one end of a broad bandage (narrow sling) over the apex of the first bandage, and sling the arm, tying the knot on the top of the shoulder. Turn down the apex of the first bandage and pin it to the bandage over the outer part of the shoulder.

For the Hip.—Tie a narrow bandage round the body above the hip-bones, with the knot on the injured side. Place a triangular bandage over the injured hip, with the apex pointing upwards. Tie the ends round the thigh. Carry the apex under the first bandage, turning it down over the knot and pinning it in place.

For the Chest.—Lay a triangular bandage with the point or apex over one shoulder. Carry the ends round the waist and tie them behind. Then tie one of the ends to the apex.

For the Back.—The bandage is applied in the same way as for the front of the chest, except that it is laid over the back and the ends are tied in front.

For the Forehead, the Side of the Head, the Eye, the Limbs, the narrow bandage is used as follows: The centre is placed over the dressing, the ends are carried round the head or limb and tied in front over the dressing.

METHODS OF CARRYING.

The Two-Handed Seat is used to carry a helpless patient. Two bearers face each other on either side of the patient. Each bearer places one arm across the patient's back and grips the clothing about the hip region. They slightly raise the patient's back, and then pass their forearms under the middle of his thighs, and clasp each other's hands by interlocking the fingers.

The Three-Handed Seat is used for carrying a patient when he has injured one of his legs, one bearer leaving one hand free to support the injured limb. Supposing the patient has injured his left leg. The two bearers stand behind the patient, facing each other. The bearer to the patient's right grasps his own left wrist with his right hand, and the other bearer's right wrist with his left hand. The other bearer now grasps the first bearer's right wrist with his right hand, and the patient sits on the seat thus formed, with his arms round the bearer's neck, the left-hand bearer supporting the patient's left leg with his left hand.

The Four-Handed Seat.—The two bearers standing behind the patient grasp their left wrists with their right hands. With their left hands they grasp each other's right wrist. They stoop down, and the patient sits on the seat thus formed, and places one arm round the neck of each bearer.

In all cases the bearers rise together and step off, the left-hand bearer with the left foot, and the right-hand bearer with the right foot.

When there is only *one bearer*, the first-aid manuals recommend carrying the patient "pick-a-back," or by the fireman's lift, but such methods must only be attempted by a strong man. A girl must always procure assistance, and keep the patient warm with coverings until help arrives. If the patient is able to walk, but requires assist-

ance, this may be given by one bearer as follows: Pass your arm round the patient's waist behind, grasping the clothes at the hip. The patient passes his arm round your neck, and with your free hand you grasp his wrist. This method is very useful for helping a person with a sprained ankle, the injured ankle being next to the bearer. In all cases it is necessary to maintain rest of the injured part. Never remove a patient if fracture is suspected until the part has been put at rest by means of splints. Never allow a patient to stand on an injured limb, nor to stand at all if the back or pelvis has been injured.

AN IMPROVISED STRETCHER

can be formed from a door, a gateway, or in the following way: (1) Procure a couple of poles about 7 feet long. Turn the sleeves of two or three coats inside out, and pass the poles through the sleeves. Button the coats. The poles may be kept apart by cross-boards lashed to the ends of the stretcher with rope. (2) Sacks may be used instead of coats by passing the poles through holes made in the bottom corners.

A **Carrying-Chair** can be utilised for a patient who is able to sit upright. Brooms or poles are lashed to the upper part of the legs on either side, and one bearer grasps the ends of the poles in front and one behind.

In **carrying stretchers,** the patient is, as a general rule, carried feet foremost. In going up-hill with a patient whose legs are not injured, he is carried head foremost; in going down-hill with a patient whose legs are injured, he is carried head foremost.

In **lifting a patient,** procure if possible four bearers. Three kneel beside the patient on one side, No. 1 at the knees, No. 2 at the hips, and No. 3 at the shoulders. The other bearer, No. 4, kneels on the other side of the patient, opposite No. 2. The bearers pass their hands beneath the patient, so that No. 1 supports the legs, No. 2 the thighs and hips, and No. 3 the chest and head. No. 4 helps No. 2 to support the thighs and hips. At the word "Lift," the patient is gently lifted on to the knees of Nos. 1, 2, 3. No. 4 procures the stretcher, and places it beneath the patient, after which he helps to gently lower the patient

on to the stretcher. The patient is lifted from the stretcher in the same way. If he is to be placed on a narrow bed, the stretcher is placed on a line with the bed, the patient's head being next to the foot of the bed, and the patient is lifted right over the foot of the bed. If he is to be placed on a double bed, which is too wide to allow of the bearers stretching from either side to hold the patient, the stretcher is placed alongside the bed, and after the patient is lifted, one bearer pulls the stretcher away, the others take a step forward, and pass the patient on to the bed.

Preparation for the Doctor.—See p. 178.

CHAPTER XXXVII

HÆMORRHAGE

External and internal hæmorrhage—Signs and symptoms—Arrest of bleeding—Tourniquets—Pressure-points of the different arteries—Varicose veins—Treatment of internal hæmorrhage—Bleeding from lungs and stomach—Cerebral hæmorrhage—Bleeding from nose and ears.

In cases of accidents, when there is hæmorrhage, it is of first importance to check the flow of blood before attending to a fracture or a dislocation, or before any attempt is made to dress a wound.

External Hæmorrhage is loss of blood upon the surface of the body, which occurs when the wound involves the skin and underlying bloodvessels.

Internal Hæmorrhage is escape of blood into a cavity of the body.

The signs and symptoms of *loss of blood* are pallor, feeble pulse, weakness, thirst, giddiness, restlessness, sighing and yawning, blurring of vision, noises in the ears, going on to unconsciousness. Hæmorrhage may be *arterial*, when the blood is scarlet, and appears in spurts or jets from the side of the wound next to the heart; or *venous*, when the blood is dark red, and flows in a continuous stream (it issues from the side of the wound further from the heart); or *capillary*, when the blood is red, flowing continuously or oozing from all parts of the wound.

To Arrest Hæmorrhage.—(1) Apply pressure on the bleeding-point with a pad of clean linen or a folded handkerchief, and fasten with a bandage; (2) elevate the limb to lessen the flow of blood; (3) if the bleeding is from an artery, pass an elastic bandage round the limb immediately

above the seat of hæmorrhage, so as to compress the artery. If the blood is from a vein, apply the bandage round the limb below the wound to compress the vein.

A Tourniquet.—Instead of the elastic bandage, a tourniquet may be used. It consists of a pad applied over the pressure-point of an artery—*i.e.*, the place where the artery is near the surface, and can be easily pressed upon—a strap or bandage to encircle the limb and pad, and an arrangement for twisting the band in order to tighten it. A tourniquet may be improvised as follows: Apply a pad by folding a handkerchief with a stone inside over the pressure-point—for example, over the femoral artery, at the inner side of the thigh. A line drawn from the centre of the groin to the inner side of the back of the knee corresponds to the femoral artery, and the pad should be placed as high as possible on this line. Then encircle the limb by a narrow bandage, with its centre over the pad. Tie the ends of this bandage in a half-knot on the outer side of the thigh. Lay a stick or poker on the half-knot, and tie a reef-knot over it. Twist the stick to tighten the bandage. This presses the pad upon the artery, and stops the flow of blood from any wound below the level of the tourniquet. The stick may be locked in position by tying the ends of the bandage round it.

Pressure may be applied by a pad or with the finger to arrest hæmorrhage on the wound and at the various "pressure-points." (Study the circulation, p. 38.)

PRESSURE POINTS.

The Carotid Artery.—Apply the thumb over the line of the artery, about the middle of the neck, pressing it backwards against the backbone, the fingers of the hand lying on the neck behind.

The Facial Artery.—Press with the thumb on the facial artery, in the hollow which can be found on the edge of the jaw two fingers' breadth in front of the angle.

The Temporal Artery.—Press with the thumb in front of the upper part of the ear, where the artery may be felt pulsating.

The Occipital Artery.—Pressure is applied at a point on the scalp four fingers' breadth behind the ear.

The Subclavian Artery.—Place two fingers of the hand behind the shoulder, and press with the thumb above the centre of the collar-bone against the first rib. The patient's arm must be pressed against the body, and his head inclined towards the injured side.

The Axillary Artery.—Place a hard pad in the axilla or armpit. Apply the middle of a narrow bandage on the pad, cross the bandage above the shoulder, and tie the ends under the opposite armpit. Fasten the limb to the trunk with a broad bandage over the forearm and bent elbow.

The Brachial Artery.—Extend the limb at right angles to the body, with the palm of the hand upwards. Stand behind the limb, pass the fingers under the back of the arm, and press on the region where the seam of the coat lies in the groove on the inside of the biceps muscles. To press on the *brachial at the elbow*, bend the elbow, place a hard pad on it, and keep the elbow in this position by placing the narrow end of a bandage over the forearm, crossing it between the forearm and arm, and tying the ends round the arm.

The Radial and Ulnar Arteries can be pressed by the thumb on either side just above the wrist, where pulsations can be felt.

The Femoral Artery.—Pressure may be applied at the *groin* by placing the thumb of one hand over the centre of the groin, with the fingers behind the thigh, and the thumb of the other hand on the top of the first thumb, the fingers grasping the thigh. To find the groin, raise the foot, and the fold in the clothing on the top of the thigh will indicate the groin.

The femoral artery in the *thigh* is pressed upon at the spot already indicated in describing how to apply a tourniquet.

HÆMORRHAGE FROM VARICOSE VEINS.

Place the patient flat, raise the limb, apply a pad, and bandage over the wound; apply a pressure pad and bandage on the side away from the heart (because the bleeding is from a vein). In the case of a varicose vein it is best to apply another pad and bandage to the vein immediately

above the wound, because the valves are so injured by the varicose condition that there is apt to be a backward flow of blood along the vein, and so hæmorrhage may occur from both ends of the vein.

INTERNAL HÆMORRHAGE.

In treating internal hæmorrhage, keep the patient in a recumbent position. Undo tight clothing about the neck and chest, and allow for free circulation of air. If collapse occurs, raise the limbs and bandage them firmly from the toes to the hips, and from the fingers to the shoulder. If the seat of hæmorrhage is known, apply ice-bags over the region; if the patient is conscious, ice or cold water may be given to sip.

Hæmorrhage from the Lungs.—The blood is scarlet and frothy in appearance, because it contains bubbles of air. Treat as for internal hæmorrhage.

Hæmorrhage from the Stomach.—The blood is dark in colour, with the appearance of coffee-grounds. It may be mixed with food. Treat as for internal hæmorrhage, but give nothing by the mouth.

Cerebral Hæmorrhage.—When hæmorrhage occurs from a bloodvessel in the brain, it produces the condition known as apoplexy. The pressure of the blood upon the brain tissues cause various symptoms of compression. The patient is flushed, and the breathing stertorous. The pupils are unequal, and one side of the body may be paralysed. Keep the patient absolutely quiet and warm, raising the head. Give nothing by the mouth.

Hæmorrhage from the Nose.—Place the patient in a chair, with head thrown back and the arms raised. Apply ice or cold fomentations over the nose and nape of the neck, making the patient breathe through the mouth. If the hæmorrhage persists, the nostrils must be plugged with gauze.

Hæmorrhage from the Ears generally indicates a fracture of the base of the skull. The ears must on no account be plugged.

CHAPTER XXXVIII

ACCIDENTS

A bruise—Wounds—Bites and stings—Burns and scalds—Electric shock and lightning—Frost-bite and chilblains.

A BLOW on the skin of sufficient severity will cause hæmorrhage beneath the skin, discoloration, and swelling. In this way a *bruise* is formed, of which " a black eye " is an example. The capillaries are ruptured, and blood escapes into the tissues; thus the skin is at first reddish, but as the blood " disintegrates," the colour changes to purple and gradually fades to a greenish-yellow as the blood is absorbed.

Treatment.—Apply ice or cold-water fomentations. A mixture of water and methylated spirit may be used (a tablespoonful to a pint of water). If lint is squeezed out of this, and applied to the part without being covered over, the evaporation will prevent swelling and reduce the pain.

WOUNDS.

There are various kinds of wounds, depending partly upon the weapon with which the injury is inflicted, partly on the nature of the wounded part or area.

Incised Wounds are produced by sharp-edged instruments.

Punctured Wounds are caused by pointed weapons.

Contused Wounds are inflicted by a blow from a blunt instrument, which causes bruising of the part and tearing of the skin.

Lacerated Wounds occur when the parts beneath are torn by machinery, or by a shot or shell, when the surface of the wound is ragged.

Poisoned or Septic Wounds result when infective material (germs) has entered the wound, either at the time of injury or subsequently.

An Abrasion is the name given to an injury when the epidermis or upper skin is removed, and the true skin beneath is exposed. Such an injury occurs when a child falls and scrapes the knee, when the wound must be carefully cleansed, or infection by germs may occur, producing a poisoned wound.

Treatment of Wounds.—The most important point in dealing with all wounds is to prevent the introduction of germs which will produce suppuration or "sepsis." If wounds are "clean," the tissues heal quickly. Material called lymph oozes out from the bloodvessels, covers the surface of the wound, and glues the tissues together. This natural process of healing is assisted if the part is kept at rest, and if the patient is in a healthy condition. In dressing wounds, the hands must first be scrubbed with soap and water with a clean nail-brush, and, if possible, soaked in a disinfectant solution before touching the patient. Any water used to cleanse the wound must be boiled, and the skin round about the injury carefully washed. Lastly, the wound itself must be cleansed by bathing with warm sterilised water or warm boracic solution in the strength of a teaspoonful of boracic powder to a tumblerful of sterilised water. Clean cotton-wool should be used as a "sponge," each little piece being destroyed after use.

A *dry dressing* is, perhaps, the best thing to use for an ordinary clean wound. It may consist of lint, which is laid on the wound, with a pad of cotton-wool on top, the dressing being kept in place by a gauze bandage.

A *wet dressing* is sometimes used if a wound is not clean, and it may consist of boracic lint wrung out of water which has been sterilised by boiling. A piece of waterproof tissue is laid on the top, and it must be large enough to overlap the wet lint by ½ inch all round. The danger in this sort of dressing is that suppuration is perhaps encouraged by the warmth and moisture; therefore it is safer to paint the unwashed and "dirty" wound with tincture of iodine, and cover it with dry gauze and a bandage.

BITES AND STINGS.

Hydrophobia may be caused by a bite from an animal (dog, cat, or wolf) suffering from rabies.

Treatment.—If a finger is bitten, encircle the finger above the wound—that is, at the base of the finger—with the finger and thumb of the other hand. Bathe the wound in a stream of warm water to encourage the flow of blood and to cleanse the part. Apply a ligature in the shape of a piece of tape or a strip of handkerchief round the finger tightly to compress the vein. Then apply a caustic, such as pure carbolic acid or nitric acid, at the end of a piece of wooden match sharpened to a point. After this is done, remove the tight band from the finger, and dress the wound in the ordinary way. When there is any risk of hydrophobia, the patient must be treated by Pasteur's inoculation treatment.

Snake-Bite.—Treat the wound in the same way, but instead of cauterising, crystals of permanganate of potash may be introduced into the wound.

Bee and Wasp Stings may produce severe symptoms of chilliness, palpitation, vomiting, and delirium. Remove the sting by squeezing between the fingers, or pressing it out with a watch-key. Apply whisky or spirits of wine or ammonia to the part. If these are not at hand, a blue-bag may be used. To counteract shock, apply a mustard plaster over the pit of the stomach, and give sips of hot milk or coffee.

BURNS AND SCALDS.

A Burn is caused by dry heat, by a corrosive, or by electricity. **A Scald** is caused by moist heat, such as hot water, oil, or tar. The extent of injury varies from—(1) reddening of the skin; (2) the formation of blisters; (3) destruction of the true skin; (4) charring of the underlying tissues. The degree of "shock" depends upon the extent and depth of the injury.

Treatment.—Remove the clothing over the injured part by snipping with scissors and soaking any adherent clothing in oil. Do not break the blisters. Cover the part as soon as possible, to exclude air, with pieces of lint or linen

soaked in oil, vaseline, lanoline, or boracic ointment. To counteract shock, apply warmth and fresh air, and give hot drinks if the patient is conscious. If the burn is caused by a corrosive acid, bathe with weak alkaline lotion (washing-soda, baking-soda, magnesia, etc.—a dessertspoonful to a basinful of water); if the burn is caused by a corrosive alkali, bathe with weak acid lotion, such as vinegar or lemon-juice, diluted with equal quantity of water.

In cases of scalds, the part may be smeared with oily substances or with a lotion of bicarbonate of soda in water (a heaped dessertspoonful to a basinful). Lint dipped in this soda solution is soothing in cases of burns.

Scalds of the Throat are caused by drinking boiling water or caustics. A sponge or flannel should be wrung out of hot water, and laid on the front and sides of the neck. Sips of cold water and teaspoonfuls of olive-oil may be given, and the patient must be kept warm.

If the Clothes catch Fire, lay the patient flat, so that the flames are uppermost. Cover with rugs or blankets or table-cover to extinguish flames.

ELECTRIC SHOCK.

Through contact with an electric wire a severe shock is sustained, and the sufferer may be unable to extricate himself. To remove him, it is necessary for the helper to insulate himself by taking hold of a non-conducting material in the hands, or by standing upon a non-conducting substance, such as dry wood or glass, dry straw or shavings. Dry goloshes or tennis-shoes also provide insulation. India-rubber gloves may be put on, or the hands protected by means of a rubber tobacco-pouch, or even a dry coat. The patient should be pulled away, and then treated for insensibility on general principles. It may be necessary to apply artificial respiration.

The Effect of Lightning is, as a rule, to produce unconsciousness. The treatment is on general lines. Any burns must be treated by local measures.

FROST-BITE AND CHILBLAINS

are produced by exposure to extreme cold, which causes arrest of circulation and destruction of the skin of the ears, fingers, toes, etc. The part must be rubbed gently with snow or with a cloth dipped in cold water. The patient must not be brought near the fire. When the patient has recovered, hot drinks may be given.

Chilblains are localised inflammations caused by intense cold. If a blister forms and breaks, an ulcer is formed, called a " broken chilblain." In the early stages, friction and the application of rectified spirits will restore circulation. If the chilblain is broken, the part must be dressed with boracic ointment or carbolic oil (1 in 40). Well-fitting boots and warm stockings help to prevent chilblains.

CHAPTER XXXIX

ACCIDENTS—*Continued*

Definition of fracture—Varieties of fracture—Signs and symptoms—Treatment—Special fractures—Unconsciousness—Concussion and compression.

A FRACTURE is a broken bone which may be produced by *direct* violence, when the bone breaks at the spot where the force is applied, or *indirect* violence, when the bone breaks at some distance from the place where the force is applied, as when the collar-bone is broken by falling upon the hand. Fractures may also be produced by *muscular contraction*, as when the knee-cap is broken by a contraction of the muscles attached to it.

Fractures are classified according to the variety and extent of the injury:

1. **Simple.**—The bone is broken clean across, and there is very little injury to the surrounding parts.

2. **Compound.**—In addition to the fracture of the bone, the skin and tissues are torn, there is an external wound, and the fractured ends may protrude through the skin.

3. **Complicated.**—The bone is broken, and there is injury to internal organs (brain, lung, etc.), or to bloodvessels and nerves.

4. **Comminuted.**—The bone is broken into several pieces.

5. **Impacted.**—The broken ends are driven one into the other.

6. **Green-Stick.**—The bone is bent or cracked without completely breaking across. This form of fracture often occurs in children, as the bones are softer and less brittle.

Signs and Symptoms of Fracture.—It is impossible for a non-medical person to definitely decide that a bone is broken, but if certain signs exist it is necessary to keep the

part at *rest* in order to prevent irreparable damage. These signs are—(1) pain; (2) loss of power in the limb; (3) swelling; (4) deformity; (5) irregularity of the bone; (6) shortening of the limb; (7) discoloration; (8) crepitus or crackling of the broken ends of bone as they are moved across each other. The last symptom should never be investigated by a non-medical person.

Treatment.—1. Steady and support the limb in case the patient should, by sudden movement, increase the damage, and perhaps convert a simple broken bone into a compound fracture.

2. Arrest any hæmorrhage, and apply a clean dressing to the wound to prevent the entrance of germs.

3. Straighten the limb gently and steadily.

4. Apply splints, which can be improvised from sticks, broom-handles, umbrellas, pieces of wood or cardboard, or folded newspapers. A "splint" is a stiff material which keeps the limb at rest. Splints are kept in place by bandages, which can be improvised from handkerchiefs, ties, belts, or strips of material. Wooden splints should always be padded with some soft material, such as cotton-wool, and applied one on either side of the limb. They should be long enough to reach beyond the joints above and below the seat of injury, thus preventing movement.

The patient must be kept warm by a blanket, and, if conscious, he should be given a hot drink.

Fractured Limbs.—Splints sufficiently long to fix the joint above and below the fracture must be used. The splints should be padded, and tied in place with narrow bandages or strips of material.

Fracture of the Ribs.—If the lungs are injured, blood may be coughed up, and in such cases no bandages, etc., should be applied to the chest. The patient should be laid down, inclining towards the injured side. Clothing should be loosened, and the arm on the injured side should be supported in a large sling. Ice may be given to suck, and an ice-bag should be placed over the seat of injury. If the *lungs* are *not injured*, apply a broad bandage round the chest, the centre of the bandage being placed over the upper part of the seat of pain. A second bandage is applied to overlap the lower half of the first. The ends of the folded bandages are tied on the opposite side of the

chest. The forearm on the injured side should be supported in a large sling.

Fracture of the Jaw is indicated by pain, irregularity of the teeth, hæmorrhage, dribbling, difficulty in speaking or eating, crepitus. The centre of a narrow bandage should be placed over the chin, the one end being carried over the head, and crossed over the other at the angle of the jaw. The long end is then carried once more across the chin, and the two ends are tied.

Fracture of the Skull.—A blow on the head may produce fracture of the skull, either of the upper part or of the base. In the latter case, there may be hæmorrhage under the conjunctiva of the eye, from the ear, or from the nose. The patient is unconscious, and treatment consists in placing him on a bed or couch until the doctor arrives. Keep the patient quiet and at absolute rest. In all cases of fracture of the skull there is compression, causing unconsciousness.

EXAMINATION OF AN UNCONSCIOUS PERSON.

The pulse should be felt to ascertain if the heart is beating, and the patient's breathing examined. The pupils of the eye should be inspected to discover if they are equal or unequal, dilated or contracted. If unequal, the indication is that one side of the brain has been more seriously injured than the other. The scalp should be examined for wounds, the limbs and body for various injuries. Hæmorrhage from the nose, mouth or ears may be present.

Treatment.—In all cases the patient must be laid on his back. If the face is pale, the head must be kept on a line with the body; if the face is flushed, the head should be raised in such a way as to allow a free passage of air through the windpipe. The clothing should be loosened from the neck and chest, and plenty of fresh air should be provided. Under no circumstances should any fluid or food be given to an unconscious person.

Concussion comprises a stunning due to shaking of the brain, without injury to its substance. In **compression,** there is injury or pressure upon the brain substance. Thus the condition is more serious than concussion, although treatment for both cases comes under the heading of insensibility or unconsciousness (see above).

CHAPTER XL

ACCIDENTS—*Continued*

Injuries to joints—Foreign bodies—Fits and faintings—Sunstrokes —Infantile convulsions—Asphyxia—Hanging and strangulation—Choking and suffocation.

Joints may be strained, sprained, or dislocated as a result of violence. A **strain** is a stretching of the muscles and ligaments; a **sprain** is a tearing of these structures; whilst a **dislocation** is a displacement of the ends of the bones from each other, with injury to the structures round the joint.

Treatment consists in keeping the part at rest, and applying compresses of flannel or other material wrung out of cold water. These compresses prevent swelling, and, when they cease to alleviate pain, apply hot fomentations whilst awaiting the arrival of the doctor.

Foreign Body in the Eye.—Pull down the eyelid, and if the foreign body is seen, wet the corner of a handkerchief and remove it. If the foreign body is beneath the upper eyelid, lift the lid forward and push up the lower lid. If this is not sufficient to brush away the foreign body, send for a doctor. If medical skill cannot be obtained, stand behind the patient, steady the head against the chest, and place a match or small bodkin along the upper lid about $\frac{1}{5}$ inch above the eyelashes. Press the fingers towards the eyeball, and pull the upper eyelashes over the match to evert the lid. The foreign body can then be removed. If a piece of steel is embedded in the eyeball, drop a little castor-oil on the eye. Apply a pad of Gamgee tissue or cotton-wool over the eye, and keep it in place with a narrow bandage, the ends of which are crossed behind the head and tied in front over the pad. If quicklime enters

the eye, brush away as much as possible. Bathe the eye with equal parts of vinegar and lime-water, or with bicarbonate of soda and water.

Foreign Body in the Ear.—Pour a little olive-oil into the ear-passages, when in most cases the foreign body will float to the surface. Do not syringe or probe the ear. If this treatment is not sufficient, send for a doctor.

Foreign Body in the Nose. — Give pepper or snuff to induce sneezing, or tickle the nostril. If the foreign body passes backwards into the pharynx and is swallowed, give a meal of potatoes or porridge and bread, which will enclose the foreign body, and later a dose of castor-oil may be administered.

Swallowing a Foreign Body.—It is not safe to give a purgative immediately a foreign body, such as a pin, has been swallowed. Meals of "stodgy" food should be given, which will enclose the sharp point and prevent injury to the internal tract. Later a purgative may be given, when the foreign article will be safely passed.

Fish-Hook in the Skin.—Cut off the dressing of the hook, and force the metal point onwards until the hook can be removed.

Needle under the Skin. A doctor should be summoned at once, and the patient kept as quiet as possible. The limb must be kept at rest with a splint.

FITS.

The chief varieties of fits are apoplectic, epileptic, and hysterical fits. (For Apoplectic Fits see Cerebral Hæmorrhage.)

Epileptic Fits generally occur in young adults. The patient falls to the ground, and passes into a state of unconsciousness. Sometimes the attack is preceded by a warning or "aura," or the patient may give a cry. Treat as for insensibility, and prevent the patient from injuring himself. Wipe the froth from the mouth, and place a pad formed from a handkerchief between the teeth.

Hysterical Fits.—In this case the person is not unconscious. The patient throws the limbs about in a purposeless manner. Treatment consists in trying to induce self-

control. It may be necessary to sprinkle the face with cold water. Hysterical patients require special treatment by a physician.

FAINTING AND COLLAPSE

may be caused by sudden emotion, or by injury. In stuffy, crowded rooms fainting or collapse may occur, and lack of food is another cause of fainting.

The Signs and Symptoms are pallor, coldness, shallow breathing, and in collapse the temperature falls below the normal, and there is serious risk to life.

Treatment.—Remove the cause and arrest any hæmorrhage. Loosen tight clothing, or take the patient from a crowded room. Lay him in a recumbent position, with the head low and the limbs raised. Give plenty of air, and stimulate the heart's action by hot milk or coffee, or sal volatile and water if the patient is conscious, or apply smelling-salts to the nostrils Keep the patient warm by means of hot bottles. Apply artificial respiration, if necessary.

SUN-STROKE AND HEAT-STROKE.

If a person is exposed to great heat or to the hot rays of the sun, certain symptoms develop—*i.e.*, sickness, giddiness, difficulty in breathing, high temperature, and insensibility.

Treatment consists in undoing the clothing after moving the patient to a shady spot. He should be laid flat, with the head raised. Plenty of fresh air should be provided, and ice-bags or cold water should be applied to the head, neck, and spine.

INFANTILE CONVULSIONS

occur in early childhood, often during teething, or in the course of stomachic derangement. The signs are spasm of the muscles, blueness of the face, and insensibility. The child should be placed in a warm bath of 99° to 100°, and a cold sponge should be applied to the top of the head.

ASPHYXIA

is insensibility produced by lack of air, and a consequent deficiency of oxygen in the blood, which also contains excess of carbonic acid. The condition may be brought about—(1) by obstruction of the air-passages by water, as in drowning, by a foreign body in the throat, by swelling of the throat structures, as in corrosive-poisoning or scald of the throat; (2) by pressure on the chest preventing movements of respiration, as may occur in a crowd; (3) by the inhalation of poisonous gases—coal-gas, charcoal fumes, carbonic acid gas, etc.; (4) by paralysis of the nervous centre controlling respiration by certain poisons—opium, etc.—or by electric shock or lightning.

Treatment.—Remove the cause of asphyxia and promote artificial respiration, allowing the patient plenty of fresh air.

Hanging.—First-aid treatment consists in raising the body to take the weight off the rope. Cut the rope, remove it, and perform artificial respiration.

Strangulation is produced by constriction of the neck, so that the wind-pipe is pressed upon. Remove constriction and undo tight clothing. Clear the throat-passages, and perform artificial respiration.

Choking.—Pass the finger along one side of the mouth to the throat to dislodge the foreign body. If necessary, perform artificial respiration.

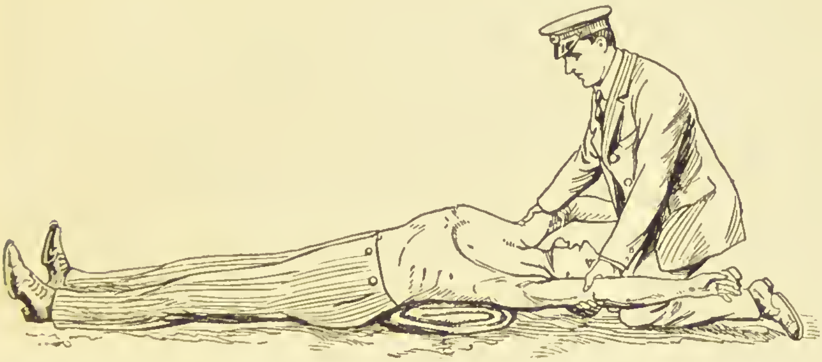
Suffocation.—This may occur from mechanical pressure over the mouth and nose, or as a result of inhaling smoke, etc. To assist a person in a burning house, take a handkerchief folded to a triangle and lay it across the bridge of the nose. Tie it at the nape of the neck, so that the apex of the handkerchief hangs down in front of the mouth. Before entering a room full of smoke, it is necessary to take two or three deep inspirations, and then go into the room in a crawling position, and remove the patient. Give the person plenty of fresh air, and apply artificial respiration.

DROWNING.

When a drowning person is recovered from the water, all water, froth, seaweed, etc., should be removed from the

mouth. The clothing should be taken off down to the waist, the patient turned downwards with a pad below the chest, and with the forehead resting upon the right forearm. Pressure should be applied with the hands to the patient's back, over the lower part of the thorax. Then turn the patient on the right side, and repeat these movements, which are frequently described as *Marshall Hall's* method of artificial respiration. If this is not sufficient to restore animation, apply Sylvester's method.

Sylvester's Method.—(1) Place the patient on his back, with the chest bare, and loosen the clothing below the waist region. (2) Raise the shoulders by placing a folded coat or firm cushion under the shoulder-blades. (3) Draw the tongue forwards, fixing it to the lower jaw with tape or



SYLVESTER'S METHOD OF ARTIFICIAL RESPIRATION.

handkerchief. (4) Induce movements of respiration. Kneel behind the patient's head and grasp the forearms just below the elbow. Bring the elbows upwards and backwards in a sweeping movement above the patient's head. By this means the cavity of the chest is enlarged, so that air is drawn into the lungs.

Expiration may be induced by carrying the patient's arms forwards and downwards, pressing the elbows firmly against the chest on either side of the sternum. Keep up artificial respiration until the patient begins to breathe. Restore the circulation by wrapping him in hot blankets and by rubbing the limbs in a direction towards the heart. When the patient is conscious hot drinks may be given. Linseed-meal poultices should be applied to the chest.

Schäfer's Method.—The patient is laid face downwards on the ground, with the head to one side, the arms pulled up above the head with the palms downwards. The helper kneels beside the patient, and places the hands on either side of the lower part of the ribs, with the thumbs nearly touching at the middle line. The helper presses forwards upon the body to expel air from the chest, and then relaxes.

Laborde's Method.—If the arms or ribs are broken, these methods cannot be carried out, but respiration may be induced after wiping out the mouth and throat passages by seizing the tongue in a handkerchief and depressing the lower jaw, the tongue being pulled outwards, and then allowed to go back.

Repeat all movements of artificial respiration at the rate of fifteen to eighteen times a minute.

POISONING ACCIDENTS.*

1. Send for a doctor.
2. Give copious drinks of milk, or flour and cream beaten together. Then two raw eggs beaten up with milk.
3. Give an emetic.

If the mouth and lips are stained or burned (indicating that acid or alkali has been swallowed), an *emetic* must *never* be given.

Simple emetics are—

(*a*) A tablespoonful of salt in a tumblerful of tepid water.

(*b*) A dessertspoonful of mustard in a tumblerful of lukewarm water.

4. Strong boiled tea is a neutraliser of a number of poisons and a stimulant at the same time.
5. Treat shock by keeping the patient warm and quiet.

Poisons.	Treatment.
Acids.	
Carbolic acid. Sulphuric acid (oil of vitriol). Nitric acid. Oxalic acid (salts of lemon or salts of sorrel). Hydrochloric acid (spirits of salt).	Wash the mouth with lime-water, whiting and water, chalk and water, wall-plaster, or other alkaline mixture. Let the patient sip some, and afterwards give milk and olive-oil. Treat shock by keeping the patient warm.

* From "Perfect Health for Women and Children," by Dr. Elizabeth Sloan Chesser.

Poisons	Treatment.
Alkalies.	
Caustic potash. Caustic soda. Quicklime. Strong ammonia.	Wash mouth with an acid mixture, such as vinegar and water in equal quantity, or lemon-juice and water. Then give milk, oil, and eggs beaten up with milk. Treat shock.
Narcotics.	
Preparations of opium (morphia, laudanum, chlorodyne).	Give an emetic. Prevent the patient from going to sleep by walking him about, flicking his face and chest with towels wrung out of cold water, applying smelling-salts, and giving drinks of hot coffee, etc.
Poisoned Meat, etc.	
Poisoned meat, fish, or fungi (such as mushrooms).	Give an emetic and castor-oil. Hot poultices or fomentations to the abdomen, warmth to the limbs.
Mineral Poisons.	
Arsenic (found in vermin destroyers, artificial flowers, dyes, wall-papers). Antimony (tartar emetic). Lead (paints and several hair-dyes). Mercury (in disinfectants). Phosphorus (rat and other poisons). Zinc (disinfectants).	Give an emetic. Give milk, raw eggs, olive-oil, strong tea. Apply poultices to the abdomen. Do not give any oil in phosphorus-poisoning.
Deliriants.	
Belladonna (deadly nightshade). Henbane (hyoscyamus). Strychnia, or nux vomica (vermin killer). Aconite (liniments). Laburnum-seeds. Holly-berries.	Emetic, strong coffee, artificial respiration, heat to abdomen, heart, etc.

Alcohol.

In acute alcoholic-poisoning an emetic and black coffee should be given before insensibility occurs. Keep the body warm to counteract shock (a state of collapse from drink sometimes occurs if a small quantity of alcohol is taken on an empty stomach. The patient should be treated for shock.

CHAPTER XLI

THE CHILD

Comparison, child and adult—Growth—Height and weight—Hygienic environment.

Much that has been said about the anatomy and physiology of the different systems of the body can be applied to children as well as to adults. There are certain differences, of course, owing to the fact that the child is growing rapidly. The proportions of a child differ from those of an adult, especially with respect to size of head and relative size of the limbs. In a new-born infant, the length or height of the head compared with the body is as 1 to 4. In the adult the height is as 1 to 7. Whilst the infant's face is small, the brain is relatively large, as the brain grows rapidly in early childhood. The period of most rapid growth is during the first nine months, when the brain increases one-third of the total increase between birth and maturity. Between nine months and three years the brain increases another third, after which growth is less rapid and less marked.

With regard to the limbs, the child has relatively longer arms and shorter legs than the adult. It has a smaller chest, and the girth of the abdomen is larger in childhood than the girth of the chest.

GROWTH.

In childhood the bones contain a smaller percentage of mineral matter, and therefore they are less brittle. A child's bones are richly supplied with blood for nourishment during growth, and layers of new bone beneath the periosteum are continuously formed to ensure increase in thickness. At the end of the long bones we have the "epiphysis," which consists of a layer of cartilage running

across the bone, and separating the shaft from the end or extremity. The cells in this cartilage are constantly multiplying to form new bone. Lime salts are deposited in the cells thus formed, and in this way the bones increase in length. A child has a large proportion of cartilage in its bones, as a provision for growth. The whole skeleton is much more flexible than is the case with the adult, and if an infant's skull is examined with the finger tips, it will be found that the bones in certain places have distinct gaps between their edges. A large gap between the frontal bone and the parietals is called the anterior fontanelle, and the pulsations of the bloodvessels of the brain can be seen and felt at this place. The flat bones grow, as has previously been mentioned, at their edges, and they increase in thickness as the periosteum forms new layers of cells. The fontanelles gradually diminish in size, and in a healthy child the anterior fontanelle is practically closed at about eighteen months. Owing to the comparative softness of the bones in childhood, wrong postures and bad habits of sitting and standing may bring about permanent deformity. In the disease known as "rickets" the bones are unusually soft, and various deformities, such as knock-knees and bow-legs, will result from the bones bending under the child's weight.

Growth and development are very largely affected by environment and nurture. Nutrition is of fundamental importance in childhood. The badly nourished child is pale, thin, and undersized. In health there should be a continuous increase in height and weight. The average height and weight according to the age are given in the table on p. 212.

Defective growth may indicate improper feeding, latent disease, or some obstruction to health, such as the presence of adenoids.

HYGIENIC ENVIRONMENT.

Every child requires, if he is to develop normally, good food, ample fresh air and sunshine, moderate exercise, and sufficient rest and sleep. The nursery and the schoolroom must conform to the laws of hygiene and health. A child's room should be light, sunny, and well ventilated. A room with a south and west exposure is more suitable for a nursery than a room facing north (see p. 106).

HEIGHT, WEIGHT, AND CHEST MEASUREMENT.

Age.	Sex.	Height in Inches.	Weight in Pounds.	Chest Circumference in Inches.
At birth	Girls	20·5	7·1	13·0
	Boys	20·6	7·5	13·4
6 months	Girls	25·0	15·5	16·1
	Boys	25·4	16·0	16·5
12 months	Girls	28·7	19·8	17·4
	Boys	29·0	20·5	18·0
1½ years	Girls	29·7	22·0	18·0
	Boys	30·0	22·8	18·5
2 years	Girls	32·5	25·5	18·5
	Boys	32·5	26·5	19·0
3 years	Girls	35·0	30·0	19·8
	Boys	35·0	31·2	20·1
4 years	Girls	38·0	34·0	20·7
	Boys	38·0	35·0	20·7
5 years	Girls	41·4	39·8	21·0
	Boys	41·7	41·2	21·5
6 years	Girls	43·0	43·8	22·8
	Boys	44·0	45·0	23·2
7 years	Girls	45·9	48·0	23·3
	Boys	46·0	49·5	23·7

CHAPTER XLII

THE CHILD'S DIET AND CLOTHING

Nursery meals—Sensible clothing—Exercise and rest—Games—Signs of ill-health.

THE diet of children is all-important. It is necessary to give a child ample fat and starchy foods and proteins in the proper proportion. A child should be given three times as much carbohydrate food as animal food, and perhaps three-fourths as much fatty material as nitrogenous food. For example, if a child has one part of meat, it should have four parts of bread, potatoes, and milk pudding combined, and less than one part of fat material, in the form of fat meat, butter, suet-pudding, cream. In most cases children are given far too much starchy food—rice, tapioca, sago, etc.—with the result that most children detest what they call " milk puddings," and can hardly be induced to eat them. Such puddings should be varied with custard, junket, jellies, stewed fruit and cream, and in winter suet-puddings with fruit or jam-rolls are suitable. Children should not have too many meals. After two and a half years, three meals a day—at 8 a.m., 1 p.m., and 5 p.m.—with a cup of milk or cocoa at bed-time, if that is delayed until seven or later—are ample.

Nursery Breakfast.—Lightly-cooked egg is an invaluable food for children, if not given too frequently. A child is easily satiated with any food, so that eggs must be varied with fish or bacon, or a plateful of well-cooked porridge and milk, followed by a little stewed fruit. An orange is an excellent and inexpensive addition to a child's breakfast. Bread and butter, or toast and butter, and cocoa served with milk, should be provided.

Nursery Dinner.—There are many nourishing soups, such as lentil soup, haricot bean soup, or meat-broths with

vegetables, which are especially suitable for children. Soup may be followed by a little mutton or chicken, occasionally a little beef, which is less easily digested, fish, rabbit, sweetbread, etc. Some well-cooked green vegetables and potatoes and a little good gravy should be served with the meat. Milk puddings, stewed fruit, junket, suet puddings, provide a choice of "sweets." A child should be given water to drink, but not until the end of the meal, as it is not good to bite and sip alternately.

Tea.—"Tea" ought to be a good solid meal. Young children should be given cocoa or milk rather than tea, whilst bread and butter should be served with honey, treacle, syrup, good jam, or jelly, and occasionally a little plain cake may be provided. Fruit in season may be served at this meal, if preferred, rather than at breakfast.

Diet after Weaning Stage.—The foods mentioned above are suitable for children of any age over two years. After twelve months a child is gradually given bread and milk, oatmeal porridge, egg, fish, gravy, vegetables, minced meat, until, at two and a half years, the meals described above will be found quite suitable. As children get bigger they require more food, but the amount must vary according to the appetite, the health, the amount of exercise, etc. No definite rules can be laid down. Good management must entail the exercise of common sense. Food between meals should be forbidden; and whilst children should be allowed sweets in moderation, they should be given after meals. Cold meat, pickles, condiments, stodgy pastry, and, of course, alcoholic beverages, are unsuitable for children. Flesh foods should be given only once a day (see Chapter XVIII.). A child can be taught to eat noiselessly, quietly, and daintily, to chew his food thoroughly. He should not be permitted to be "troublesome" about what he will and will not eat, although a child's taste must be considered, and he need not be forced to take food that is apparently distasteful to him.

SENSIBLE CLOTHING.

The question of clothing in general has already been considered. The child's clothing should be soft and light, loose and warm. The custom of "hardening" children by

sending them out in all weathers insufficiently clad, with limbs and neck and chest bare of clothing, is a hygienic sin, a physiological mistake. A child's body rapidly loses heat. He requires a large amount of nerve force and vitality for breathing, for digesting his food, for growth and development, and if he has to expend an undue amount of energy in maintaining body-heat, his various functions are deprived of energy, so that he is liable to digestive derangement, to chest and lung affections, and to undue fatigue. At the same time, children should not be overclothed with too many and too heavy garments; they will get overheated, perspire profusely, and contract chill, because their damp clothes are kept in contact with the skin. The essential garments are woollen combinations (long-sleeved in winter), a vest to which knickers are attached, a jersey, and a serge skirt in the case of a girl. In summer, the jersey may be replaced by a shirt or blouse. There should be no constriction of the waist, and suspenders should be worn, attached to the vest, to which stockings can be fastened. Boots and shoes must be well-fitting, so that no pressure is exerted upon the toes, and the feet are permitted to maintain their normal shape. Every attention should be paid to the soles, as damp feet are a frequent cause of chill. The heels should be broad and low, and children should be encouraged to change their shoes for house-slippers on coming indoors. Stockings should be hung up to air at night, and changed two or three times a week, and boots or shoes should never be worn on two consecutive days. In hot weather children may go without shoes and stockings, but light sandles should always be worn to protect the feet from injury. A child should not be allowed to wear any garment during the night that has been worn in the daytime.

EXERCISE AND REST.

A healthy child, throughout his waking hours, is in more or less constant motion, full of restless energy and high spirits. A child requires to have plenty of exercise in the open air; but if he is keen on games, he may play until overfatigued, and so some measure of restraint may be necessary. Other children, again, require to be encouraged to play. They may be of inferior physique to children of

their own age, and incapable of holding their own, but a wise choice of games in such cases, and the giving of encouragement, will do good in many ways. Children who are working at lessons and playing games also require definite periods of rest and long hours of sleep. A child should sleep the round of the clock up to nine or ten years of age. The schoolboy of from ten to twelve should have ten hours sleep, and all through the years of later school and college life nine hours' sleep should be regarded as necessary to health.

SIGNS OF ILL-HEALTH.

Fretfulness and irritability are signs that a child is being improperly fed or insufficiently rested. The healthy child is happy and contented. If a child is listless, slack, lacking interest, there is something the matter. It may be that he requires better hygienic conditions, more food or less food, or food of a different kind, more fresh air and sleep, fewer lessons and games. There may be some medical reason, such as the presence of adenoids and enlarged tonsils, some eye defect, such as an error of refraction; but these are points which only a doctor can diagnose. Lack of appetite and lassitude may be signs of a commencing infectious disease, whilst elevation of temperature is an indication that a child should be put to bed and a doctor summoned. Children are often irritable because they are suffering from an inability to digest their food. They may be having too much starchy food or too much animal food, their teeth may be requiring attention; whilst another cause of irritability, as has been said, is insufficient sleep. Light meals combined with early bedtime is one of the best remedies for bad temper. At the same time, highly strung children of the neurotic or nervous type, who are not taught to control themselves, are consequently bad-tempered and unhappy. Every child must be taught self-control. "Should children be punished?" is a question that is frequently asked. Physical chastisement should be unnecessary if children are properly managed from the beginning. Punishment can take the form of depriving the child of some luxury or treat, or of sending him earlier to bed.

CHAPTER XLIII

BABY'S TOILET, CLOTHES, AND DIET

Bathing and dressing baby—Baby's meals—Care of the bottles—Improper feeding.

So much has been said concerning the importance of a knowledge of infant and child care that many people are advocating that every girl, whatever her social position may be, should have some teaching in this particular subject included in her school curriculum. No course of hygiene can be considered complete without some reference to infant management, but lack of space prevents more than a brief résumé of this important subject. It is during the first year that the child requires most attention and care, if he is to have a fair chance to live and to develop on normal lines.

Baby's Toilet.—When the child awakens in the morning, after what should be a refreshing and restful sleep, he must be bathed. A suitable bath should be procured and filled with water, the temperature of which must be tested by a thermometer. In early infancy the water should be about 100° F. This temperature is generally reduced as baby gets older, until at six months the temperature of the bath is 80° F. The temperature of the water should not be tested by the hand. If a thermometer is not available, the tip of the elbow should be placed in the water and kept there for a few seconds. Baby must be supported in his bath with the nurse's forearm and hand, the child's back lying against the left forearm. Before he is put in the bath, eyes, ears, and face must be cleansed. Have a little basin of warm water beside you, with some pieces of clean cotton-wool; dip one of these "sponges" in the water and squeeze it over each eye in turn. Wash the nose and the ears gently, then the face. Soap baby's scalp and body, then put him into the bath, wash him with the water,

and dry very carefully afterwards. The ears especially must be thoroughly dried, or baby may develop eczema. Then dust with equal parts of starch and boracic acid powder when baby is ready to be dressed. Powdering is partly used to prevent " scalding "; but if baby is carefully washed (all soap being carefully removed) and thoroughly dried, there is not much danger of this occurring.

Baby's Clothing.—A little loose flannel binder and a soft woollen vest are the first garments to be put on; then the napkin, the short flannel and the long flannel are laid on the knee, and baby is placed on them so that they may both be fastened at once. The dress should be slipped over the feet, the arms gently put through, and the dress fastened behind. All garments must be thoroughly aired previously; then baby should be warmly wrapped up after breakfast and be put to bed for his morning sleep.

BABY'S DIET.

Whilst it is, of course, always desirable that the infant should be nursed by his own mother, this is not always possible, so that something must be said regarding baby's bottles. Cleanliness is of first importance. Every effort must be made to procure pure milk, and to safeguard it from contamination by dust or flies, by keeping it in jugs sterilised by boiling water, and covered with clean muslin. If the source of the milk is not absolutely safe, it should be *pasteurised* in the following way whenever it arrives at the house:

Have a double saucepan, which is kept for the purpose, and put the milk in the upper pan. The lower pan should be filled with water which has been brought to the boil, and kept at this temperature for twenty minutes. The milk does not boil, because the boiling-point of milk is higher than that of water, but it is kept at a temperature which destroys all microbes and their spores. The milk must afterwards be placed in a jug which has been scoured or sterilised with boiling water.

The Care of the Bottles.—Two boat-shaped bottles should be used, each bottle having a teat at one end and a valve at the other. These should be washed thoroughly in hot water every night, using the brush which is supplied with

the bottle. In the morning, bottles, teats, etc., also the little jug which is used for filling the bottle, must be *boiled*. These are first washed and then placed in a large saucepan kept for the purpose, full of cold water. If the bottles are put in cold water, and, after boiling, the saucepan is set aside to cool before the contents are removed, there is no danger of the bottles cracking. After cooling, the bottles, etc., are put in an enamel basin full of clean cold water, and this is placed on a tray, which also contains the jug of fresh milk, covered with muslin, and the small jug used for filling.

Preparation of Milk and Barley-Water.—Milk should be diluted before it is given to baby, but the doctor must advise upon the amount of dilution. As a rule a baby is, during the first month, given equal parts of milk and barley-water, and the following table will serve as a guide to the strength and quantity of each feed, according to the age of the child:

Age.	Quantity at One Meal.	Intervals.	Number of Meals in 24 Hours.	Average Weight.
1st month	½ oz. milk, ½ oz. water or barley-water	2 hours	10	End of 1st month, 8 lbs.
2nd month	1 oz. milk, 1 oz. water or barley-water	2½ ,,	10, gradually decreased to 9	End of 2nd month, 9½ to 10 lbs.
3rd month	2 ozs. milk, 1 oz. water or barley-water	2½ ,,	8	End of 3rd month, 11 lbs.
4th and 5th months	5 ozs. milk, 1 oz. water or barley-water	3 ,,	7	End of 5th month, 14 lbs.
6th to 9th months	6 to 8 ozs. milk	3½ ,,	6	End of 7th month, 16 lbs.; end of 9th month, 18 lbs.

Half a teaspoonful of cream should be added to each bottle, and a pinch of lactose or sugar of milk. When there is any difficulty in digesting the starchy material in the barley-water (which is extremely useful in breaking up the large curd in the cow's milk), half a teaspoonful of malt extract may be added to each bottle. Barley-water for baby's use is prepared in the following way:

Two pints of water should be placed in a covered saucepan with 2 teaspoonfuls of best prepared barley, and boiled down to about a pint and a half, then strained and mixed with pasteurised milk in the proper proportions according to the age.

WEIGHING THE BABY.

Contentment, good appetite, and regular gain in weight, are signs of a thriving baby. Baby should be weighed once a week at least. For average weight at different ages, see table, p. 212. The weekly increase after the first month should be about 5 ounces, although after the sixth month the average weekly increase will be a little less, and the amount varies considerably.

Dangers of Improper Feeding.—A child's health is so dependent upon good digestion, that the proper feeding of baby is the most important matter in child management. Improper or irregular feeding will produce sickness, vomiting, diarrhœa, and loss of weight, baby becomes thin and peevish, and suffers unduly from teething and other vicissitudes of infant life. If baby is constipated the addition of cream to the bottle will probably counteract the tendency, whilst diarrhœa is a sign of digestive derangement. The doctor should be consulted, and he will probably change the diet and prescribe castor-oil to get rid of the undigested material in the intestines. Another cause of diarrhœa is chill, due to damp napkins.

The Napkins must be thoroughly washed and boiled daily, after which they must be carefully dried and aired. No soda should be used for washing, as that causes irritation or chafing. Care must be taken that the napkin is not put on too tightly.

CHAPTER XLIV

BABY'S HEALTH

The bed—Baby's outings—Ills of infancy—Vaccination—Early signs of illness.

EVERY child must sleep in a cot by himself from the beginning. The best bed is a white enamel or brass cot, with the sides arranged so that they can be moved easily up and down. He should lie on a firm hair mattress, with a pillow and light warm blankets. In cold weather an eiderdown may be supplied. The bed and bedclothing should be aired every day at an open window or before a fire. In the early months of infancy, baby sleeps practically all the time, awakening only for food. Until well on in the first year he will have a morning and afternoon nap, and this should be kept up as long as possible. Lack of fresh air is a frequent cause of sleeplessness, and when a baby is sleeping badly he must be taken out of doors as much as possible.

Baby's Outing.—A roomy perambulator with good springs, sufficiently large to allow baby to lie flat comfortably, is the best baby carriage. Mail-carts are suitable enough for children over two years, but the small go-carts or push-chairs, in which a child sits in an upright position, close to the ground, are undesirable in many respects. In the first place, it is not good for a child's spine to sit for several hours in this position; secondly, it is difficult to keep the extremities warm; and thirdly, the child inhales dust and germs when he is so close to the ground. No child under two years should ever be placed in such a chair. Regular outings in the sunshine and fresh air will help baby to thrive, and he should be given as much sunshine as

possible, so long as the sun is not allowed to shine directly upon the head or eyes. A proper awning should be provided over baby's carriage in summer.

ILLS OF INFANCY.

If baby is managed on the lines suggested, he should go through the first year without contracting any infant ailments, and even without suffering any inconvenience from teething. Teething is a natural physiological process, which should not be attended by adverse symptoms, and many ills blamed on the " teeth " are due to improper feeding and bad management.

Teething is associated with increased flow of saliva or " dribbling." The gums are also a little tender, but there ought not to be pain or sickness or high temperature. Careful diet and good management will generally prevent teething troubles. The " comforter " is a frequent source of illness at this period. It is allowed to lie about and is then placed in baby's mouth. It causes microbic infection and induces " thrush," whilst the constant sucking encourages an excessive flow of saliva, which interferes with digestion. Comforters should be banished from every well-regulated nursery. To protect baby from chill, caused by dribbling, a little indiarubber bib should be worn underneath the ordinary bib. The mouth may be occasionally washed out with a little boracic lotion, and baby requires sips of water to relieve thirst.

Vaccination.—Every child should be vaccinated when he is about three or four months old, before teething begins. A baby should not be vaccinated when his health is below par for any reason, because the slight fever and bodily disturbance which vaccination entails will pull him down in health still further. When baby is vaccinated, his diet should be very carefully watched. He should be taken out into the fresh air as much as possible. The arms should be protected with a piece of antiseptic gauze, stitched to the dress at the shoulder to prevent it from slipping.

Early Signs of Illness.—Anyone in charge of a baby must be able to recognise early signs of illness. Certain signs point to the need of a doctor being called, because delay

in the case of a young child may have serious results. **Colic** means pain in the abdomen, which causes baby to scream and to pull his knees up in an effort to relieve the pain. If baby is fretful and crying, if he has no appetite, or if he vomits his food persistently, if he seems flushed, and especially if the thermometer registers a temperature 98·4° F., he is certainly not well. Rise of temperature should be taken as a sign that the doctor should be in attendance. It is always better to risk calling in a doctor unnecessarily than to delay in obtaining medical advice, on the chance that baby will get better without treatment.

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